A COMPUTERIZED TENDERING MODEL FOR THE CIVIL ENGINEERING CONSTRUCTION COMPANY

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ABSTRACT

Tendering in the construction industry is still more an art than a science, possibly because of the complexity of the nature of civil engineering job with each project being unique and distinct. Tendering process is further complicated by the vast difference among various Contractors in their capacity and experience, also, company policy varies as to percentage of market share required and target profit.

Over ninety percent of Contractors in Hong Kong are still making tenders manually. Nevertheless, some of the tendering works is so routine and repetitive that it is more efficient if undertaken by a computer. This study is an attempt to standardise and computerise some of the tendering works.

This report describes the system build up, the rationale behind each programme and the actual programming. The relative usefulness and practicality of the system is also tested against actual tender.

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CHAPTER I

INTRODUCTION

During the past years a number of technical developments in computer hardware and software have combined to open many new possibilities in computer application to small contractors. As a manager of a small firm in the construction field, one has most certainly been aware of computer applications that have been developed and used successfully by larger firms. Thanks to the technological advancement, even a small firm can now share the harvest of the age of computerisation.

This is made possible by the release for sale of greatly improved micro-computer equipment, known generally as the '16 bit personal computer' in 1982 and 1983. In particular, this new equipment brings together greater computering power and lower costs in a package that is small enough to sit on the desk of an executive. The second major development is a small low-cost hard magnetic disc file wich can store the large volume of data, only now are these files available at a cost where they can efficiently be used in a computer system for a small contractor.

Two recent developments in software also help to make this possible. The first is the so called 'user-friendly' software. These programs permit novice users to operate the system efficiently by using a series of questions that leads a person step by step through each operation. The

second software innovation is the Data Base Management System (DBMS) which is designed to integrate and simplify the processing of the many different types of data files necessary to control all aspects of a construction project.

Evolution of a Project

In Hong Kong, when a developer (client) want to have a project - be it a housing development, bridge construction or a sewage treatment work - constructed, he will first employ a Engineering Consultant to conduct a feasibility study. The consultant, after knowing the general requirement of the project from the client, will proceed with a detailed investigation, and, depending on the size of the project, produce a report within 6 months to 2 years entailing some or all of the following suggestion/estimation:

a) The location of site

b) The size of the project

c) The time required for construction

d) The cash flow projection

e) Any other legal and enviromental considerations

f) Technical considerations & recommendations

After studying the report, if the client is still in favor of having the project implemented, and is able to raise the neccessary financial resources, he will signal to the Consultant to proceed with the detailed

design. Baring any unforeseeable changes, the designs produced this time will be the actual shape of the structure upon completion, except only that all of them will be on drawings.

Role of the Contractor

The consultant Engineer is an expert in design, but not necessary - and usually not - at the same time an expert in the actual execution of the project. For this, he has to rely upon various construction firms/contractors who have over the years developed their special skills in various fields in Civil Engineering Construction. Those companies (especially the International Construction Firm) are able to organise over thousands of worker within a relatively short period, and have sufficient plant, equipment and expert knowledge to have the project completed satisfactorily in time.

Purpose of Open Tendering

To ensure fair competition and to guard fully the interest of the client, open tendering is adopted for nearly every project carried out in Hong Kong. When the Consultant Engineer has finished with his design, he will invit several contracting firms (who have to be registered with the Public Works Department of Hong Kong Government) to collect tender documents from the Engineer.

The tender documents consist of

1) Form of Tender
2) Articles of Agreement and Conditions of Contract
3) General Specification - indicating the standard of material and workmanship expected
4) Particular Specification - Pinpointing other requirements that are particular to these project
5) Bill of Quantities - which catagorise items of different nature
6) One set of drawing - indicating the location, shape and size of finished product

From the information gathered on the tender document the Contractors have a fair picture of what is required. Allowing a reasonable time (usually 3-4 weeks) for working on the tender, the Contractors have to turn in before a certain date, the tender together with their firm offers of price they are willing to carry out the work.

After checking, other things being equal, the client will usually accept the lowest tender, though it might not always be the case.

Procedures in Estimating a Tender Price

Basically, all costs of a construction work item are composed of:

a) Material cost

b) Labour cost

c) Cost of Plant and Equipment usage

d) Cost of Consumables (fuel & oil)

e) Supervision and Profit

In Hong Kong, nearly 99% of all those estimation are still done manually. When an estimator receives an assignment to do a certain tender, he will send out enquires to suppliers and subcontractors for updated material cost; and based on his personal construction knowledge (or sometimes work in conjunction with the company's Engineering Department), he tries to estimate the average output of a certain activity, its plant and labour requirements and thus arrives at the corresponding labour, plant and consumable costs. The cost of supervision depends very much on the nature and size of the project and hence the personnal requirement, whereas the profit is a matter of Company Policy.

In theory, if we have a sufficient large computer which can store all up to date material costs, and have assess to all historical costs and production speeds; we can have the entire tendering work load undertook by a computer. However such is not the case, and rightly so, due to of the following reasons:

1) Unlike manufacturing, not one Civil Engineering Contract is the same, and for most of the contracts, they are not even similar,

hence historical data are usually not applicable

2) Tendering is more of an Art than a Science, subjective assumptions exist in nearly every item of the tender, which assumption is nearer to truth can only be verified when the work is actually carried out

3) The actual selling price of a tender depends on factors such as - company's Profit policy; the estimator's vision of the future economic condition; the amount of jobs the company has in hand; the type of experience, personnel and equipment available; also the general market demand - when jobs are few then competition will be severe, and vise versa

4) Even for works of the same nature, e.g. concreting, much will depend on the location of site (is it near to a rock quarry), the time of the year when the work is being carried out (in wet season or in dry season) and the quantities involved

Objective of the Study

It is not the intention of this research to design a comprehensive program to cover all aspects of tendering process, rather, it is hoped that through this research, some of routine process in tendering (information gathering and recording, breaking down of items into smaller basic elements

and carry out arithmatical calculation on each element) can be processed with the aid of a micro-computer, and implement this into the actual tendering process of a small construction company.

It is intended that through actual testing and re-design, a workable system can be developed that can provide the estimator a powerful tool to take care of those tedious computation in tendering so as to facilitate tendering accuracy and speed. More over, it allows the estimator more time to ponder upon questions that are more important - pricing strategies, tender programming and construction sequencing.

CHAPTER II

METHODOLOGY

The research will be conducted in four stages:-

1) Building Up Data File

This is achieved by detail investigation of various format of Bill of Quantity and summarise items that are common to all. The purpose is to

- identify items that can actually be routinised
- store data that will be useful for later programming purposes
- if a change in specification requires new or modified rate to be developed, this could be done more efficiently

2) Programming for Various Work Items

As there is no available commercial packages on this specific field, and the lack of reference technical paper, all of the programs are developed from scratch. Item that are identified in (1) as programmable will all be processed.

3) Proof Checking Using Existing Contracts

Preliminary checking of all the programs will be made

against the company's existing contracts that were successfully tendered. Discrepencies and area for improvement can be revealed at this stage.

4) Actual Site Test on Real Tender

The final test for the practicality of the programme will be made in the firm's actual tendering of future contracts. The accuracy of the outcomes will then decide the amount of refinement required for the programme.

Hardware and Software

The hardware requirement is restricted by the firm's existing system set up, which comprises of a micro-computer (Apple II) with two disc drives. The printer is a letter quality daisy-wheel type which when not occurpied can be used as an ordinary typewriter. The monitar screen is NEC Brand.

Apart from the build in packages, the only software system purchased is a Word Proccessor which is quite unrelated to the project. All programmes are developed in BASIC Language under the CP/M system.

The General hardware requirement for a microcomputer system and the current software features (CP/M operating system) are attached in Illustration 1 (A) and (B).

Illustration 1 - (A)

GENERAL HARDWARE REQUIREMENT FOR A MICROCOMPUTER SYSTEM

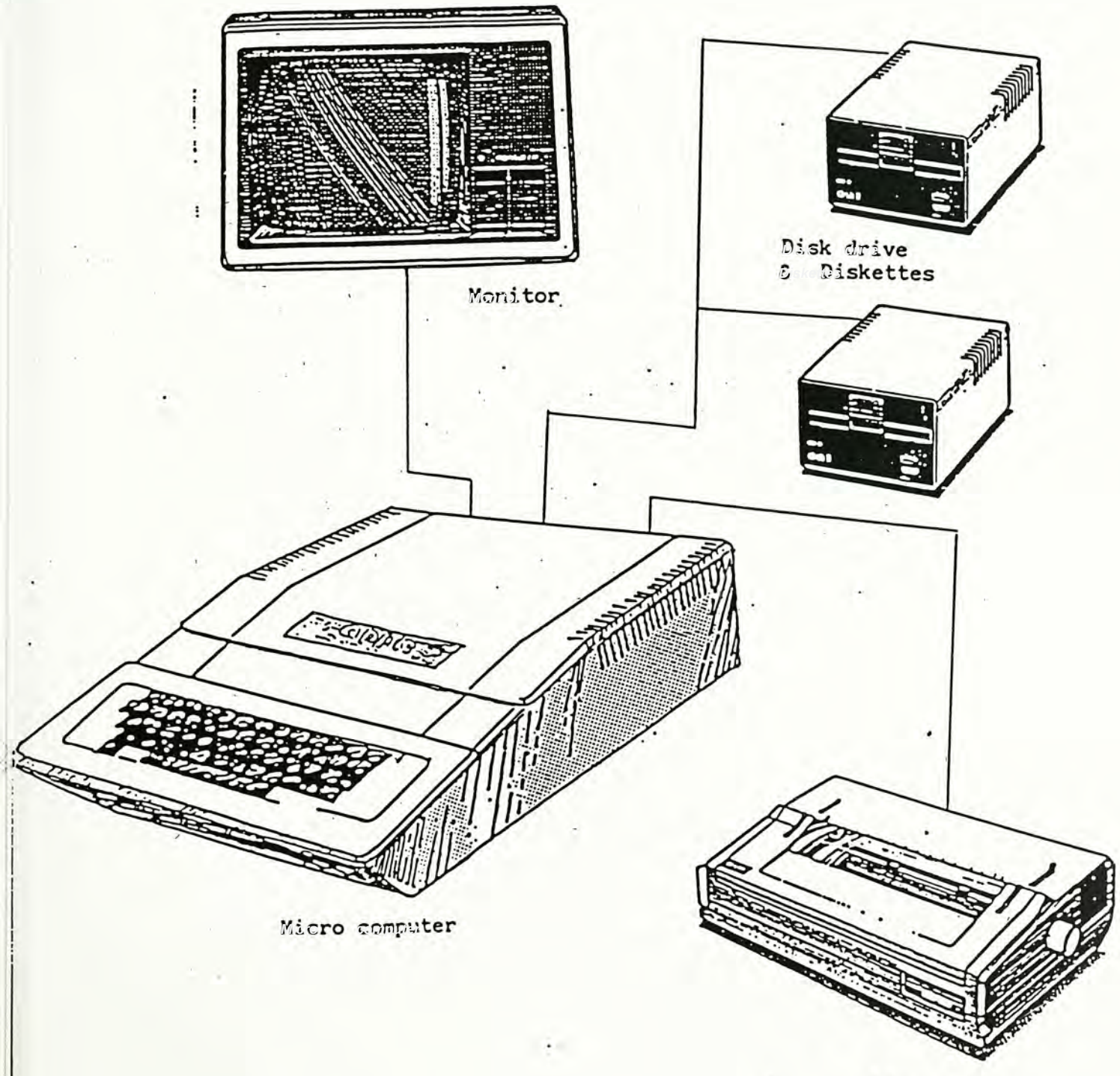

Illustration 1 - (B)

CURRENT SOFTWARE FEATURES (CP/M OPERATING SYSTEM)

(1) 64 K bytes memory and 6502 CPU

(2) CP/M Master disk
CP/M ,stands for CONTROL PROGRAM FOR MICROCOMPUTERS, which is an operating system widely used all over the world.

(3) Build-in Commands
- assist in the operation within diskette

DIR -- Directory
ERA -- Erase files
REN -- Rename files
STAT -- Status
TYPE -- Type files
USR -- User

(4) Transient Program
- being stored in disk for different purpose
e.g. debugging

(5) Filename Structure
- a filename is made up of any 8 charaters and an extension

(6) File Types (Extension)
- to identify the purpose or structure of a file

.COM -- Command file
.BAS -- MBASIC file
.BAK -- Back-up file
.$$$ -- Temporary file
.DAT -- Data file
.TXT -- Text file

(7) File Structure
- files are built up with ACCOUNT, EXTENSION, RECORD and BYTE ,presented in diskette

CHAPTER III

BUILDING UP DATA FILE

Bill of Quantities

As mentioned, one of the documents of the set of tender documents is the Bill of Quantities. Bill of Quantities means a list of items giving brief identifying descriptions and estimated quantities of work comprised in the execution of the works to be performed. The Bill of Quantities is intended in the first instance to give information upon which tenders can be obtained. When a Contract has been entered into, the function of the priced Bill of Quantities is to provide for the valuation of the work executed. (See appendix I for sample of Bill of Quantities)

The item discriptions used in the Bill of Quantities identify the work covered by the respective items, and the rates and prices to be inserted in the Bill of Quantities are to be considered as the full inclusive rates and prices for the finished work and as covering all labour, materials, temporary work, plant, overhead changes an profit, as well as the general liabilities, obligations and risks arising out of the Conditions of the Contract

Items in Bill of Quantities

For clarity and uniformity, all items in a Bill of Quantities are divided into sections, the grouping and classification of which are predetermined by the Public Works Department, now Lands and Works Department. An illustration of the Bill of Quantities is given in Table I.

Table I

Sections in Bill of Quantities

Section	1	General Preliminary
Section	2	Site Clearance
Section	4	Fencing and Walls
Section	5	Drainage and Service Ducts
Section	6	Earthworks
Section	8	Sub-base and Road Base
Section	9	Flexible Surfacing
Section	10	Concrete Carriageway
Section	11	Footways, Cycle Tracks, Paving and Kerbing
Section	12	Traffic Signs, Road Marking and Emergency Telephones
Section	13	Piling for Structures
Section	14	Formwork for Structures
Section	15	Steel Reinforcement for Structures
Section	16	Concrete for Structures
Section	17	In-site Post-Tensioned Pretressing for Structure
Section	18	Fabrication of Steel Work
Section	19	Protection of Steel Work Against Corrosion
Section	20	Waterproofing for Structures
Section	21	Bridge Bearings
Section	22	Vehicle Parapets
Section	23	Movement Joints for Structures
Section	27	Testing
Section	30	Finishing, Painting and Finishes
Section	31	Miscellaneous

Sections That are Programmed

In theory, all sections in the Bill of Quantities can be programmed and have the tendering work undertaken by a computer. In practice, this is both tedious and expensive, a simple telephone enquiry upon a sub-contractor is more convenient and efficient, thus, for the present project, programmes are written only for five sections, namely Section 1 - General Preliminary, Section 14, 15, 16 - Structural Works and Section 5 - Drainage and service ducts. These sections are chosen because of their representiveness and tremendous saving in manual labour once estimate of cost for these sections is computerised. These sections are still vulnerable to price fluctuation for different site conditions, but to a much lesser degree than other sections, hence not too much variable has to be taken into account in programming.

Type of Data to be Stored in the Data File

Basically, costs of any item in a Bill of Quantities consist of

a) Material cost e.g. Cement, aggregates, steel, timber etc.

b) Labour cost for handling, placing, operating, forming, fixing, reinstatement

c) Associated plant costs where applicable.

d) Costs of consumables (fuel and oil)

e) Site Supervisions

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d) Costs of consumables (fuel and oil)

e) Site Supervisions

f) Head office overhead

g) Profit and risk

Among these seven, material, labour and consumable are the elements that are easier to quantified and less subject to changes due to company's policy as overheads & profits, thus only records of these are kept in the data file.

Materials that are commonly used in construction feld are: stone aggregates, cement, timber, steel reinforcement, pipes (concrete or PVC), bricks, bitumen, explosives etc. Record of latest costs of these material are being kept in the file and is updated whenever there is a price change.

Labour and consumables are of a lesser variety than material, usually only three to four trades of labourer are important as the company in concern concentrates mainly on earth moving projects and hence the labour content is not significant. Consumable consists mainly fuel and oil, with industrial diesel fuel a major constituent - nearly 90% of total consumables.

Sources of Information

For rise and fall in basic material costs, the trend can be traced by refering to Building Contractr Association's quarterly publication on prices of over 10 common construction material (see appendix II).

Information on labour index employed in the programme comes from three sources, the official one is the monthly publication by Statistical Department of Hong Kong Government, which is supplemented by the updated company's existing average labour rate, a third source is the rates quoted by Sub-contractors who work on a piece work basis. Sometimes the sub-contrator's rate may contain material element, but this can be taken into account when incorporating it into the programme.

Cost of fuel is traced by refering to the monthly invoice from the oil company, the rate is slightly lower than the market price because of the reduction offered by the oil company

Structure of the Date File

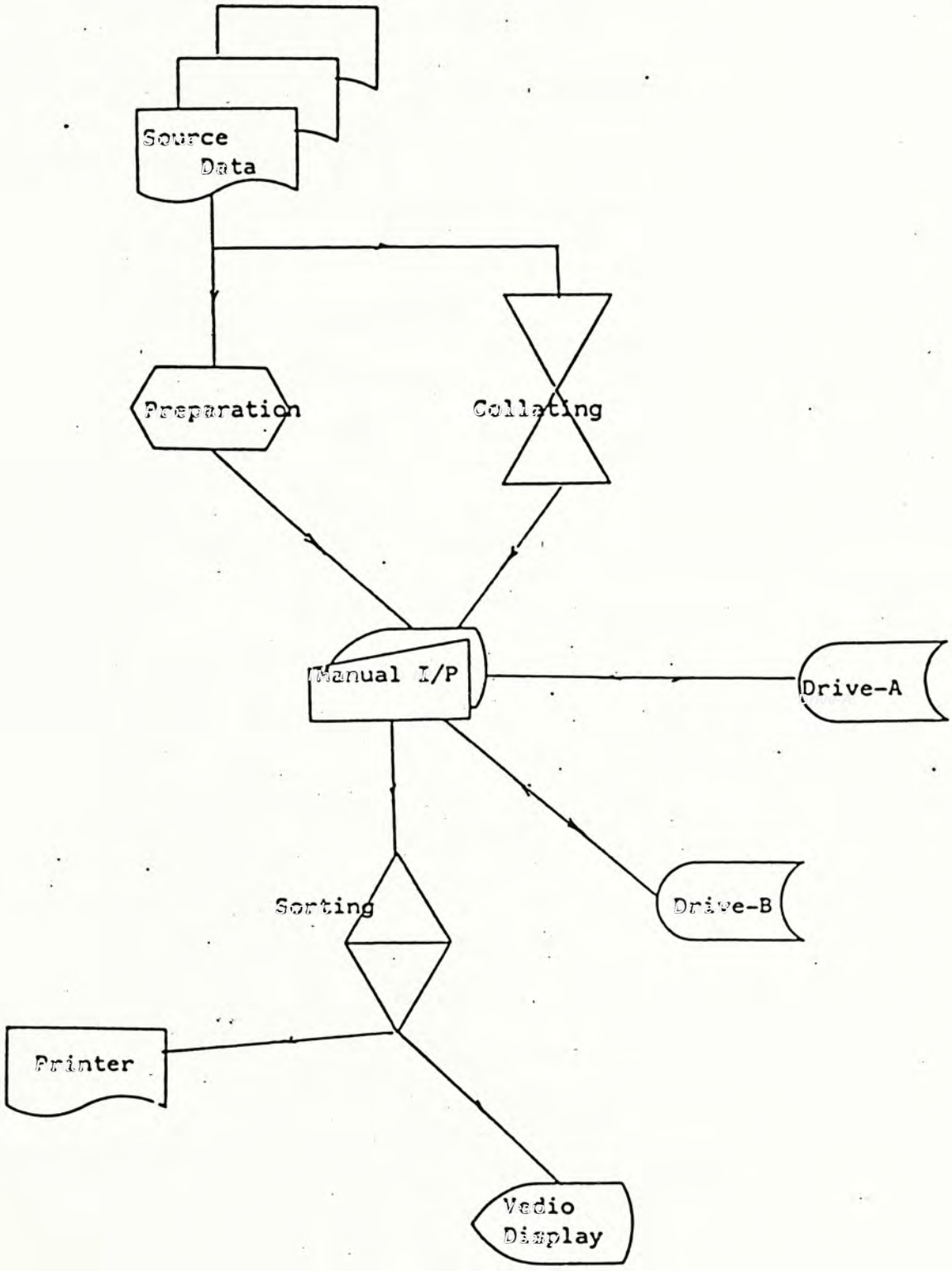
Like most other data files, the programme is written to having the following 3 functions:

1) Data retrieval
2) Date updating
3) Creating new records

System flow chart is attached in Illustration 2.

(Programme flow chart can be seen in Appendix III)

Illustration 2 - System Flow Chart of Data Files



CHAPTER IV

THE SOFTWARE

PROGRAMME ON THE PRELIMINARY SECTION

Items in Preliminary Section

The first section in any Bill of Quantities is the Preliminary section, which is the necessary work to be done to get the whole contract started or mobilised, but yet do not form part of the permanent works; examples of which are erection of office for Consultant Engineer's Representative on Site (Resident Engineer), erection of Contractor's temporary site office; watching, lighting and guarding, cost of insurances (workmen's compensation and contractor's all risk), setting out of works, provide transport to the Resident Engineer etc.

Method of Calculation and Sources of Information

For offices, as the requirement for each contract differs both in layout, size and the furniture requested, therefore a common base of calculation is the average cost per square metre; the figure of which can be found in checking the cost for erecting offices of different sizes in the contracts the company is presently undertaking, all stored in the data file.

Insurances costs varies in direct relation with contract value, thus a quick reference is the average of percentage current contract sum that comprises insurance, again, such information are stored in the data file.

Other items are also estimated in a similar manner, except that the basis of calculaton differs slightly, for setting out of works it is mainly the suming of salaries of surveyors and chainmen, and for provide transport to the Resident Engineer it is obtained by adding up the cost of vehicle plus the monthly maintenance costs, again, detail figures of which are stored in the data file, the preliminary programme only carried out the arithmatical computations as intended by the user.

System flow chart is attached in Illustration 3.

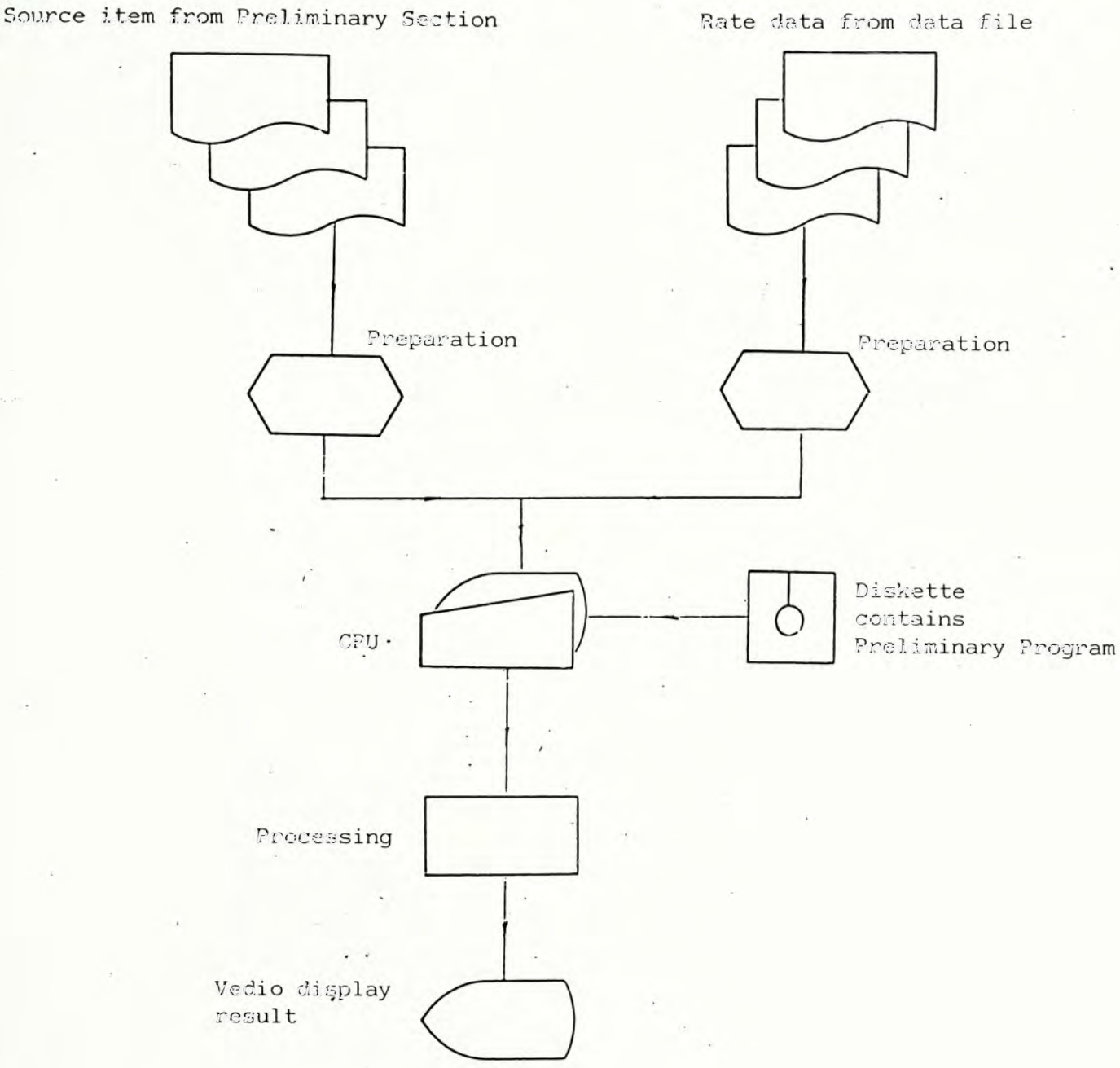
(The programme flowcharts are attached in Appendix IV)

PROGRAMME ON STRUCTURAL WORKS

Element of Concrete Structure

When structures are mentioned, in Hong Kong it usually refers to concrete structures as steel structures and timber or brick houses are rare here. All concrete structures, be it a building, a flyover, a subway or a reservoir, all consists of three basic elements, namely, formwork, which is to keep the fresh concrete in an exact shape before it hardens; steel

Illustration 3 - System Flow Chart of Preliminary Section



reinforcement and concrete. Like Preliminary Programme, this rogramme is used only for doing the arithmatic functions.

System flow chart is attached in Illustration 4.

(The programme flow charts are attached in Appendix V)

Formwork

Formwork are classified into 5 catagories, technically termed as F1, F2, F3, F4 and F5, the difference among these classes are the type of finishing required, starting from F1 (rough finish) to F5 (smooth finish with irregular surface pattern). The main cost of formwork lies in the cost of material (timber and plywood) and cost of labour for cutting, preparing and fixing. However, instead of detail calculation of cost of material and labour, a more practical approach is to trace the rate of subcontracting for current contracts, and adjusting for fluctuating in material and labour indexes

System flow chart is attached in Illustration 4.

The programme flow charts are attached in Appendix VI.

Concrete

Cost of concrete comprises of material cost (Cement, aggregates, water), cost of mixing and tranporting, and cost of placing.

Concrete is classified by its crushing strength requirement and also

the maximum aggregate size. In construction, normally eight to ten different grades of concrete will be encountered. Despite the vast difference in its nomaclature, the only significant difference in material cost being its different cement and stone aggregate content. With the prevailing various aggregate size at the same price, hence the factor affecting material cost being solely its cement content. The programme is so structured that once the grade of concrete is known, the material cost can be computed. The basic data of cost per ton of cement, and aggregate are stored in the data file.

For mixing concrete and transporting, usually the unit cost is calculated by estimating the monthly running cost of the site batching plant divided by the average monthly product. As both running cost and the production varies among contracts, these data are filled in by the estimator without refering to data file.

The cost make up of concrete placing consists mainly of labour and plant. As the total cost for placing 10 cu.m. or 15 cu.m. of concrete differs only slightly because of the limited marginal time spent, therefore in estimating the unit placing cost, a certain average volume per pour has to be assumed by the estimator to achieve the unit rate.

System flow chart is attached in Illustration 4.

(Programme flow charts are attached in Appendix VII)

Steel Reinforcement

Reinforcement for structure can be classified into High Tension Steel and Mild steel, with a material price difference of approximately 5%. For fixing steel, as the measurement is by weight, thus the labour cost for fixing smaller size bars (16mm down) will be more expensive than bars of larger diameter. Thus programme for calculating unit rate for steel fixing is divided into a) High Tension 20mm up, b) High Tension 16mm down, c) Mild Steel 20mm up and d) Mild Steel 16mm down. In building up rate, a certain percentage of wastage is being assumed and also a lump sum is allowed for transportation. The information of material cost and sub-contractor's rate for fixing steel are extracted from the Data File.

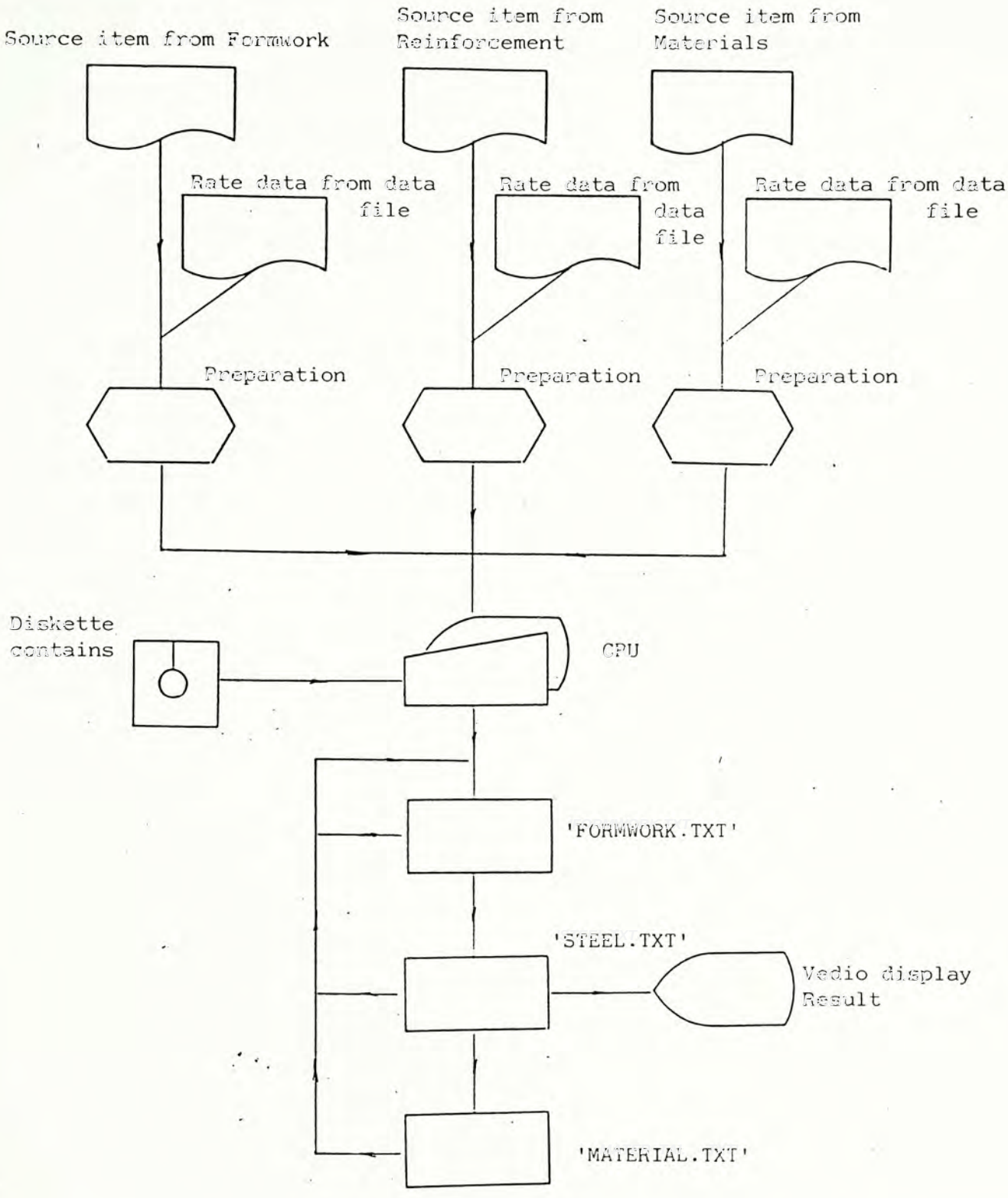
System flow chart is attached in Illustration 4.

(Programme flow charts are attached in Appendix VIII)

PROGRAMME FOR DRAINAGE ITEMS

Drainage works - pipes and channels - differs in type of pipes used; size of pipe; depth of excavation and type of bedding required. The cost make up for an items includes excavation and backfill, cost of pipe, cost of pipe laying, formwork, steel fixing and concrete. To cater for these, a question and answer approach is adopted in programme, the user is to indicate all the assumptions employed. When actual pipe detail is entered,

Illustration 4 - System Flow Chart of Structure Works

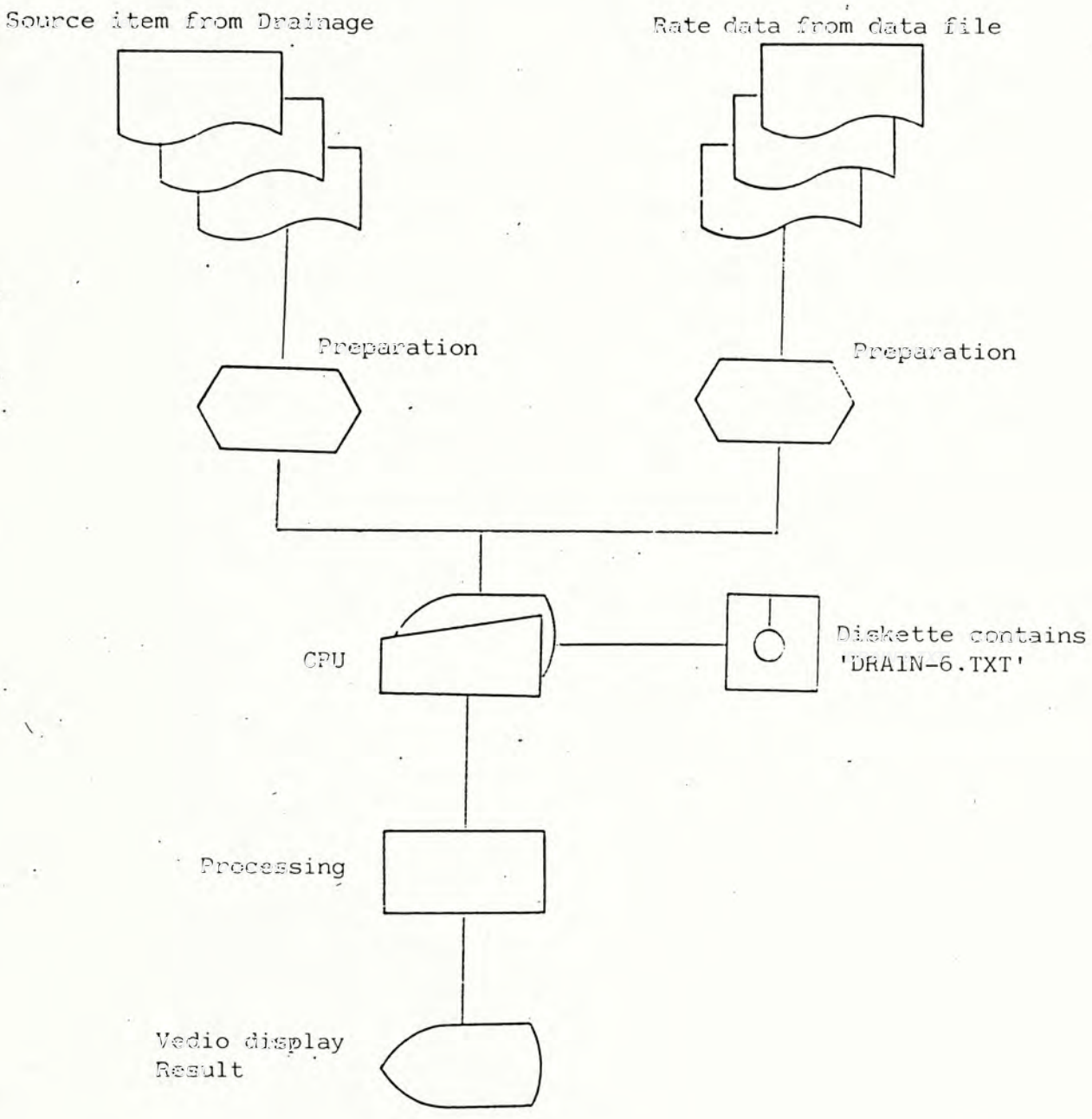


the mathematical work is undertaken by the computer. The data regarding pipe cost can be found in the file whereas rates for formwork, steel and concrete are extracted from the previous programme.

System flow chart is attached in Illustration 5.

(Programme flow chart is attached at Appendix IX)

Illustration 5 - System Flow Chart of Drainage Program



CHAPTER V

SAMPLE RUN

An existing contract, NTDD Contract No. 5/JB/82 is chosen for proof checking of the programme reliabibity. The drainage items are singled out due to the complexity of the nature of the programme.

Sample Run

The input of various rates are rates taken from other items in the same contact, and pipe costs are extracted from supplier's quotation. Theoretically if the rates so produced should tie in with the actual drainage item rates, as tendering was carried out manually, the sample run will proof both the adequacy of the programme and also the consistency of the rates. The results are attached in Appendix X.

ACTUAL SITE TEST ON REAL TENDER

Contracts Tendered

Two recent contracts were tendered using the computer system developed, namely, NTDD Contract 23/TM/82 - Box Culvert and Site Formation

in Area 2A; and Contract 10/CEO/83 Controlled Tipping of Refuse at Jorden Valley, both tender closed on March 2, 1984. Unofficial enquiry indicates that out of 25 tenderers, we are fourth lowest in Contract 10/CEO/83 and eighth lowest on Contract 23/TM/82, though the monetary difference is so substantial between the lowest and our tender that no meaningful implication can be deduced.

The vast difference can be attributed to many factors, firstly only one third of the item are calculated by computer, secondly, erroneous assumptions may exist, and mostly important of all, the company policy regarding headoffice overhead and profit affects the outcome so much that any refinement by computerisation seems redundant.

CHAPTER VI

CONCLUSION

The computer system will save a lot of time in tendering procedure, it will also be useful for future reference with regard to material ordering and cost control.

With the aid of such system, an experienced estimator can concentrate his effort on critical items in the tender and let the micro-computer do all the repetitive arithmatical calculations. The estimator will have more time in studying the programming requirements and method of construction, he can work on tendering strategies rather than crossing the t's and dotting the i's.

Outcome of the test is not that promising, but neither is it disappointing, it is expected that only by constant review and updating that one will be able to produce a computerised tendering programme that is both practical and efficient.

TENDER ADDENDUM NO. 1

BILL NO. 2 — PART 2.3
ROADWORKS AND RECLAMATION — DRAINAGE AND SERVICE DUCTS

ITEM No.	DESCRIPTION	QUANTITY	UNIT	RATE $	AMOUNT $
	Section 5				
	DRAINAGE AND SERVICE DUCTS				
	Sewers, Drains and Ducts				
A	150mm Diameter perforated rigid P.V.C. sub-soil drain in trench with 10mm aggregate surround depth to invert of 1.5 metres or less.	694	lin.m.	162.-	112,428.00
B	150mm Diameter non-perforated rigid P.V.C. subsoil drain in trench with concrete surround depth to invert of 1.5 metres or less.	71	lin.m.	144.-	10,224.00
C	225mm Diameter class 'S' sewer or drain in 'wide trench' with bedding type '1' depth to invert of 1.5 metres or less.	3	lin.m.	162.-	486.00
D	225mm Diameter class 'S' sewer or drain in 'wide trench' with bedding type '8' depth to invert of 1.5 metres or less.	243	lin.m.	234.-	56,862.00
E	300mm Diameter class 'H' sewer or drain in 'wide trench' with bedding type '1' depth to invert of over 1.5 metres average depth to invert 1,885 metres, maximum depth to invert 2.200 metres	21	lin.m.	180.-	3,780.00
F	Adjustment on last item for variation greater than 150mm above or below the average depth of 1,885 metres per 25mm of variation in excess of 150mm.	Rate Only	lin.m.	4.-	
G	375mm Diameter class 'H' sewer or drain in 'wide trench' with bedding type '1' depth to invert of 1.5 metres or less.	70	lin.m.	216.-	15,120.00
H	375mm Diameter class 'H' sewer or drain in 'wide trench' with bedding type '8' depth to invert of 1.5 metres or less.	51	lin.m.	306.-	15,606.00
	Carry forward to summary at end of Part 2.3 Drainage and Service Ducts : .			$	214,506.00

BILL NO. 2
ROADWORKS AND RECLAMATION

PART 2.3
DRAINAGE AND SERVICE DUCTS

ITEM No.	DESCRIPTION	QUANTITY	UNIT	RATE $	AMOUNT $
A	525mm Diameter class 'M' sewer or drain in 'wide trench' with bedding type '1' depth to invert of 1.5 metres or less.	29	lin.m.	387.-	11,223.00
B	525mm Diameter class 'M' sewer or drain in 'wide trench' with bedding type '1' depth to invert of over 1.5 metres, average depth to invert 1.715 metres, maximum depth to invert 2.550 metres.	126	lin.m.	414.-	52,164.00
C	Adjustment on last item for variation greater than 150 mm above or below the average depth of 1.715 metres per 25mm of variation in excess of 150 mm.	Rate Only	lin.m.	5.-	
D	600mm Diameter class 'M' sewer or drain in 'wide trench' with bedding type '1' depth to invert of 1.5 metres or less.	10	lin.m.	468.-	4,680.00
E	600mm Diameter class 'M' sewer or drain in 'wide trench' with bedding type '1' depth to invert of over 1.5 metres, average depth to invert 2.030 metres, maximum depth to invert 2.790 metres.	93	lin.m.	522.-	48,546.00
F	Adjustment on last item for variation greater than 150 mm above or below the average depth of 2.030 metres per 25mm of variation in excess of 150 mm.	Rate Only	lin.m.	6.-	
G	600mm Diameter class 'M' sewer or drain in 'wide trench' with bedding type '8' depth to invert of 1.5 metres or less.	35	lin.m.	612.-	21,420.00
H	600mm Diameter class 'M' sewer or drain in 'wide trench' with bedding type '8' and Grade 20/20 concrete surround depth to invert of 1.5 metres or less.	24	lin.m.	612.-	14,688.00
	Carry forward to summary at end of Part 2.3 Drainage and Service Ducts :			$	152,721.00

Appendix II

B. C. Association

AVERAGE WHOLESALE PRICE QUOTATIONS OF SELECTED BUILDING MATERIALS

for the month of December 1983

Mild Steel Round Bars (6mm - 40mm diameter)	$2 012.21	per tonne
Mild Steel Round Bars (20mm & above)	$1 983.16	per tonne
Mild Steel Round Bars (16mm & below)	$2 032.37	per tonne
High Tensile Steel Bars (10mm - 40mm diameter)	$2 090.43	per tonne
Portland Cement (Ordinary)	$ 425.19	per tonne
Hydrated Lime	$ 487.85	per tonne
Red Bricks (1st Grade)	$3 332.40	per 10 000 bricks
Aggregate (All Grades)	$ 73.95	per cubic metre
Sand	$ 66.50	per cubic metre

Average Daily Wages of Workers

Engaged in Government Building and Construction Projects

(New Series - Combined of L.W.B. & Housing Department)

Occupation		Wages in November 1983	
		HK$	Index (100 points = HK$20.0
Labourer (unskilled)	(male)		
Excavator	(male)		
Concreter's labourer	(male)	120.1	601
Bricklayer's labourer	(male)		
Plasterer's labourer	(male)		
Labourer (unskilled)	(female)		
Excavator	(female)		
Concreter's labourer	(female)	95.2	476
Bricklayer's labourer	(female)		
Plasterer's labourer	(female)		
Concretor			
Bricklayer		184.6	923
Drainlayer			
Bubble mason			
Splitting mason		179.8	899
Ashlar mason			
Steel bender		214.8	1 074
Blacksmith		184.1	921
Carpenter and joiner		186.9	935
Plumber		169.7	849
Fitter		153.5	768
Plasterer		187.3	937
Terrazzo and granolithic worker		191.3	957
Glazier		168.4	842
Painter		168.6	843
Electrician (Wireman)		142.8	714
Plant operator (excavator driver, bull-dozer driver, etc.)		159.7	799
Truck driver (trucks operated as plant)		141.9	710
Heavy load coolie		166.2	831
Pneumatic driller		170.2	851
Bamboo worker and scaffolder		215.0	1 075
Structural steel erector		182.4	912
Diver		287.3	1 437
Diver's lineman		138.9	695

Wages and Labour Costs Statistics Section

Census & Statistics Department

10th January, 1984

Appendix III

How to Use Data Files

HOW TO USE 'DATA-L' & 'DATA-M' AND INCOPERATE WITH APPLICATION PROGRAMMES (DRAIN.TXT , STRUCT.TXT , PL-0.TXT)

(A) General procedure in data management involving up-dating, creating new records and data retriveal.

(1) Switch on the computer and the monitor
(2) Insert pfs Master disk into disk drive which the lamp is on
(3) Close the drive door
(4) Make sure that the monitor is set to 40 colume mode
(5) Wait for a while until a pfs menu displayed on screen
(6) Replace the pfs Master disk by 'DATA-M' or 'DATA-L'

(B) For Up-dating / Data retriveal

(1) Enter '4' (search/up-date) for the 'SELECTION NUMBER'
(2) Press '→' key so as to jump to next heading -- 'FILENAME'
(3) Enter 'DATA-M' (for material data) or 'DATA-L' (for labour data)
(4) Check if the entries are correct
(5) Press CTRL-C for commencement
(6) A blank form is displayed on screen
(7) You may fill in the blank form with suitable data for searching (Press '→' for jumping next heading, press CTRL-C for action continue)
(8) Screen will change into blank until a relevant record is searched
(9) User is allowed to carry out any correction or print the current record by pressing CTRL-O
(10) User may press CTRL-C for next corresponding record
(11) Press 'ESC' to pause this action and return to menu

(C) For Creating new records

(1) Enter '2' (Adding) for creating new records
(2) You may directly press CTRL-C for action commencement
(3) A blank form is displayed for user to fill in
(4) After completion, press CTRL-C for next new form
(5) Press 'ESC' to pause this action and return to menu

Appendix IV - A

Preliminary Programme

(A) How to use / Function

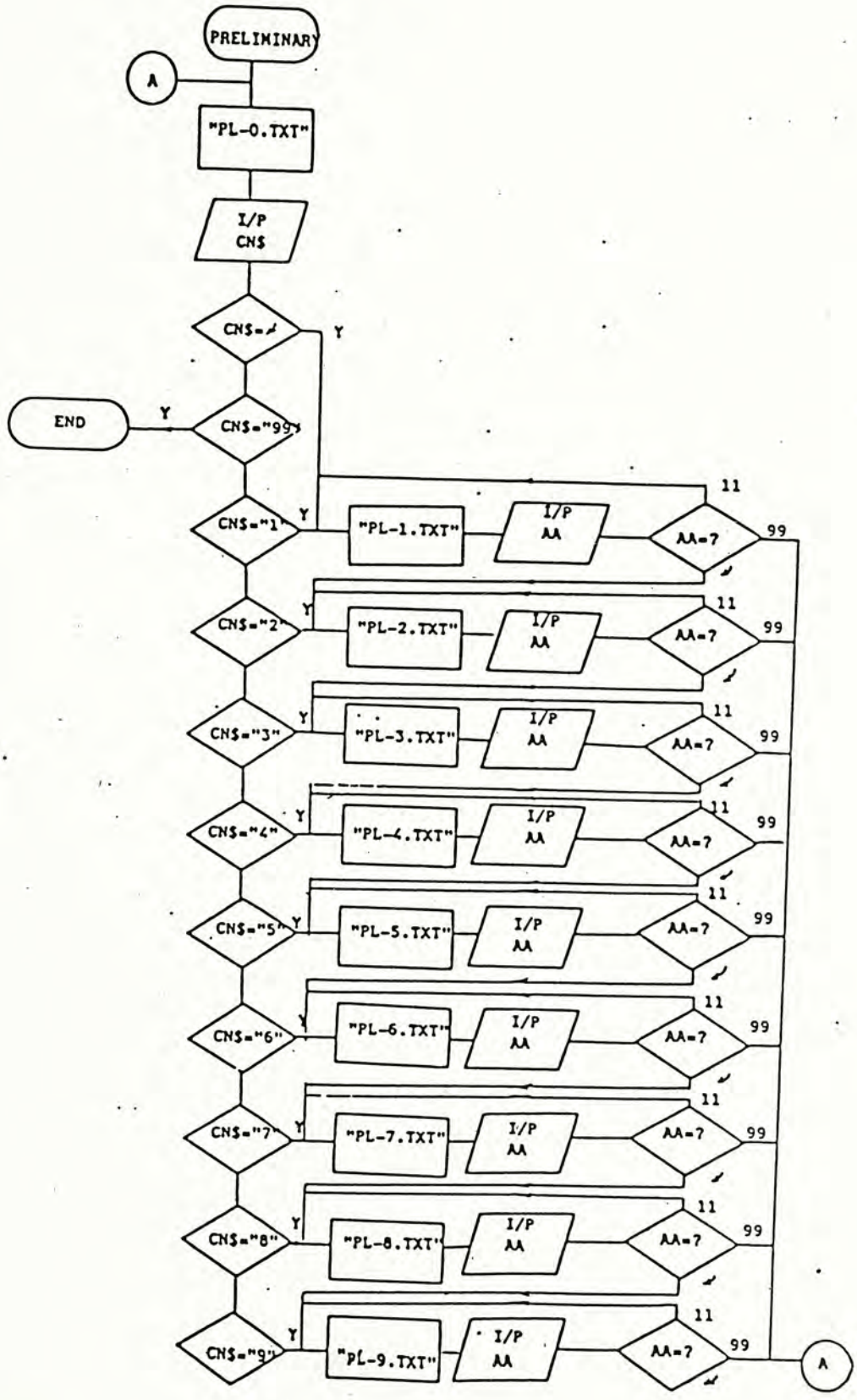
H O W T O U S E

Procedure :

(1) Switch on the computer.
(2) Switch on the monitor.
(3) Insert the proper disk into drive while the IN-USE lamp is on.
(4) Close the drive door.
(5) Use 'DIR' to check whether it is proper disk.
(6) Type in 'MBASIC'.
(7) Wait for a while until 'OK' is displayed.
(8) Type in 'LOAD "PL-0.TXT"' to load the master program from disk to CPU.
(9) Wait for a while until 'OK' is displayed.
(10) Type in 'RUN', then 'PL-0.TXT' is started.
(11) Select your choice and follow the concise instructions displayed on the screen.
(12) Usually, you may continue the program by pressing 'RETURN'.
(13) You may EXIT from program by pressing '99' at each page end.
(14) For special purpose, user may select any particular sub-program by give the no. corresponded at the 'CHOICE'.

Appendix IV - B1

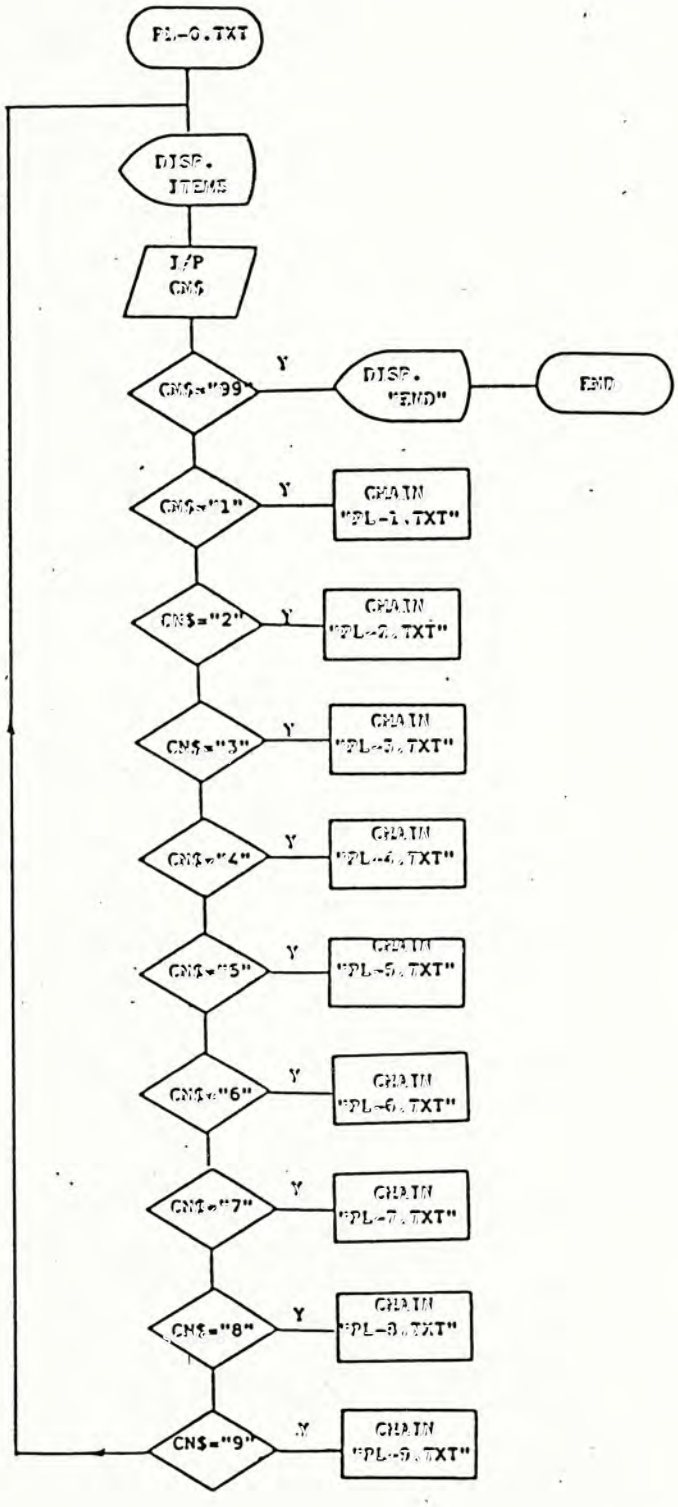
(B) Flow Charts



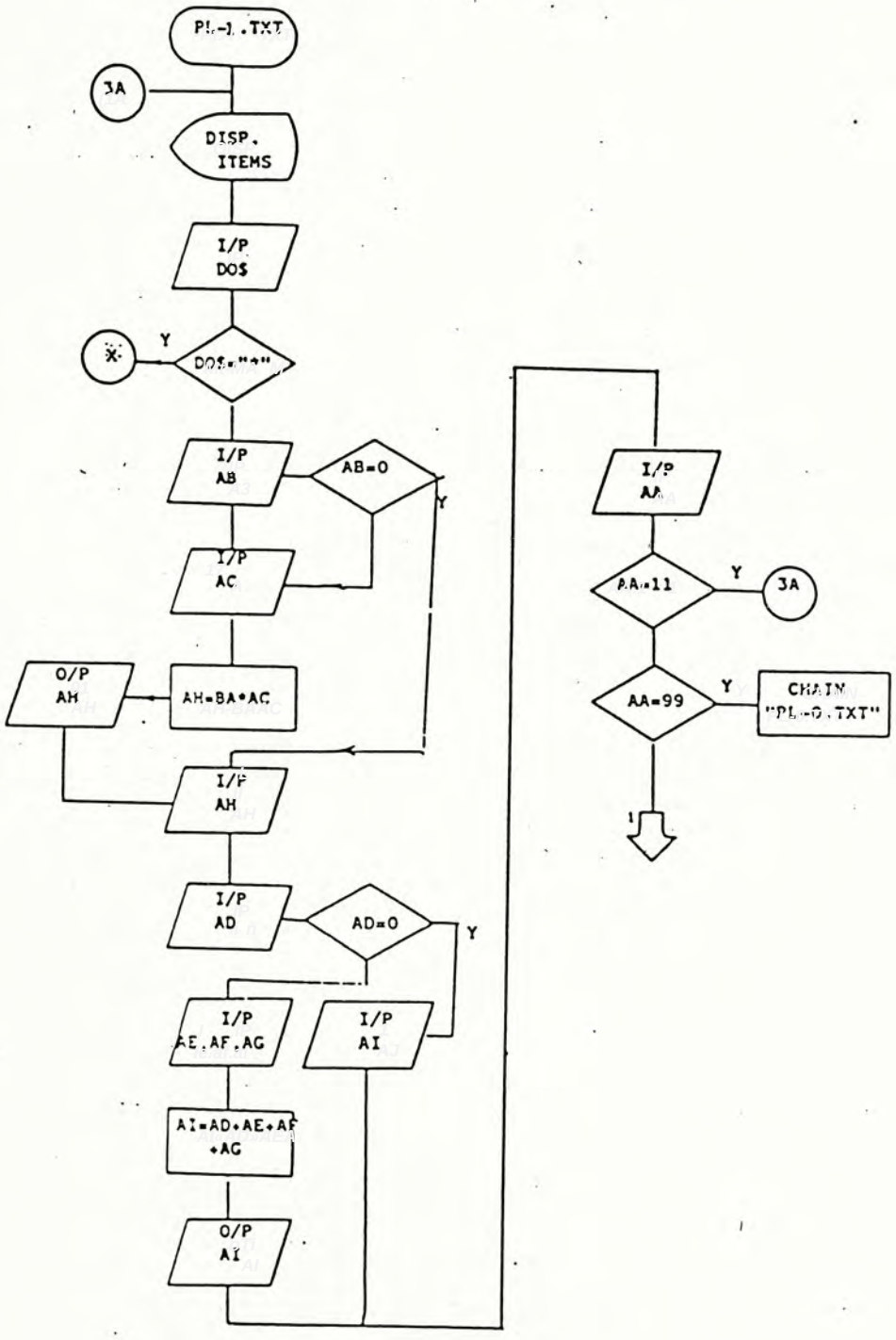
(B) Program Flow Chart of

Preliminary Program

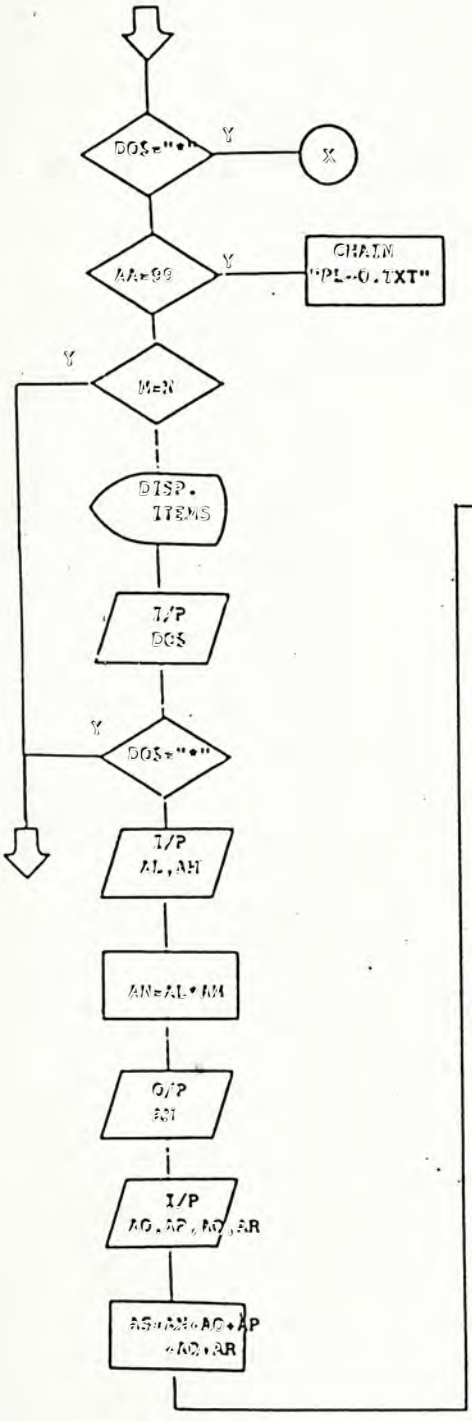
(from PL-0.TXT to PL-9.TXT)

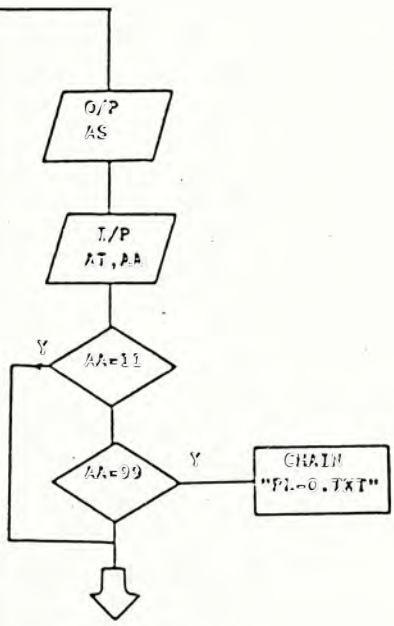


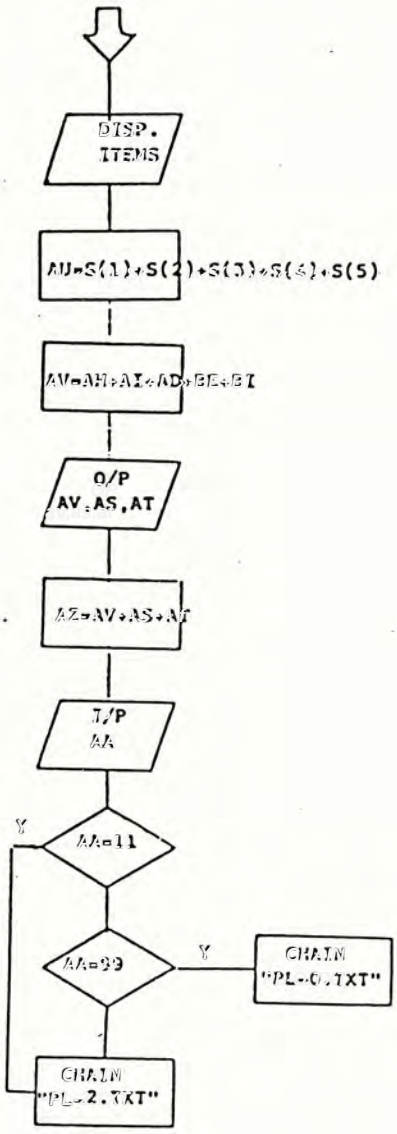
Appendix IV - B3



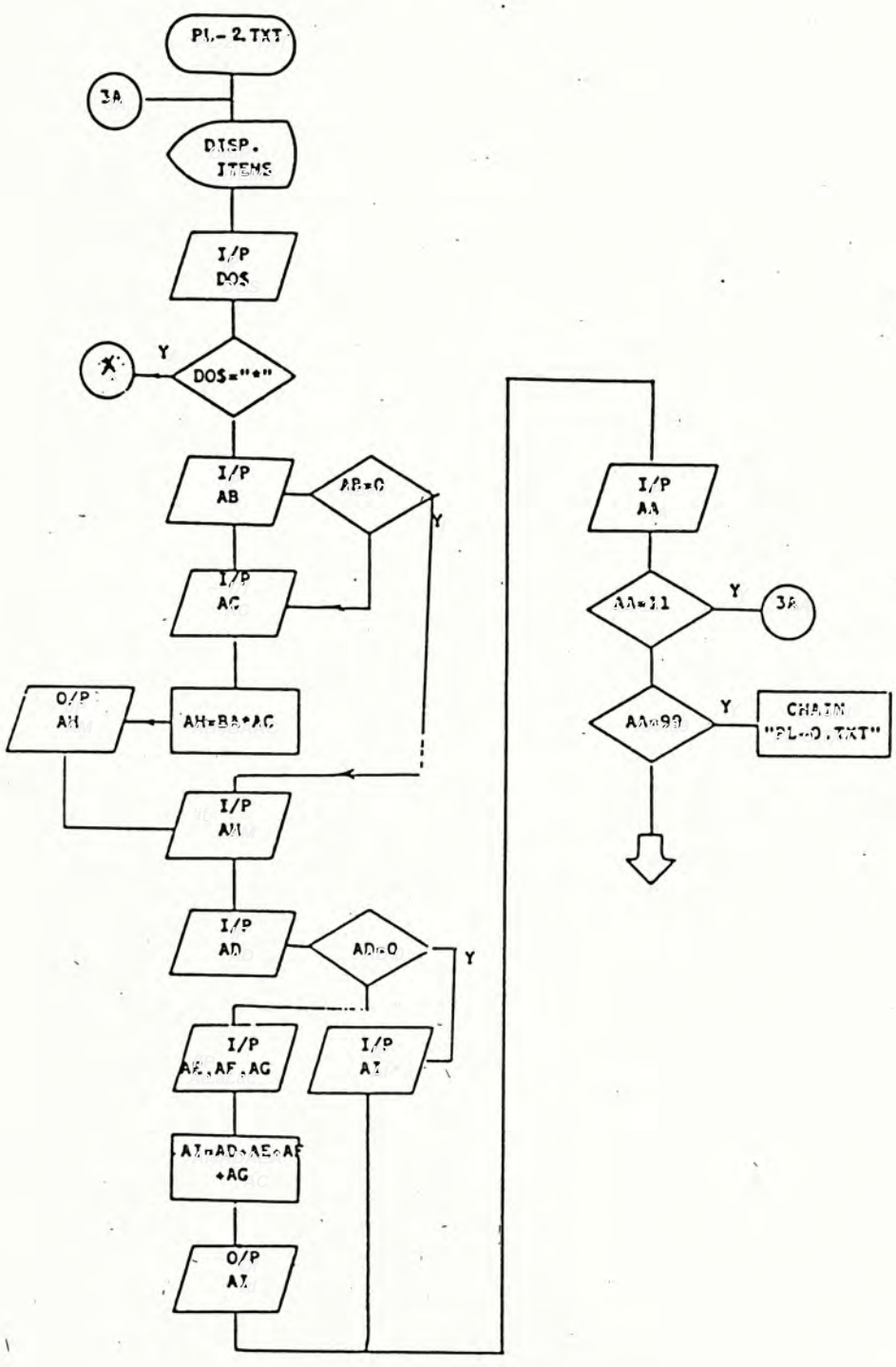
Appendix IV - B4

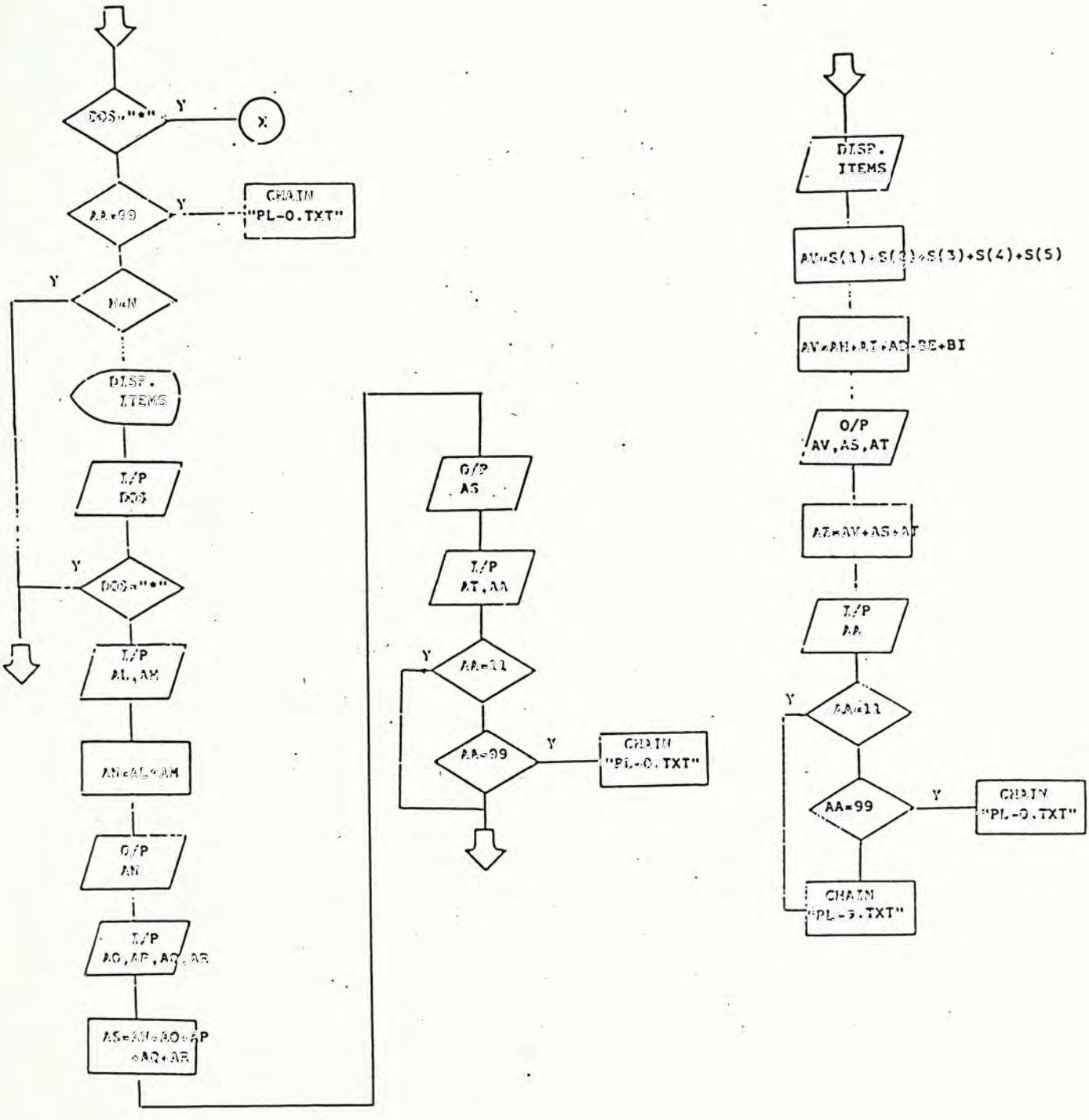


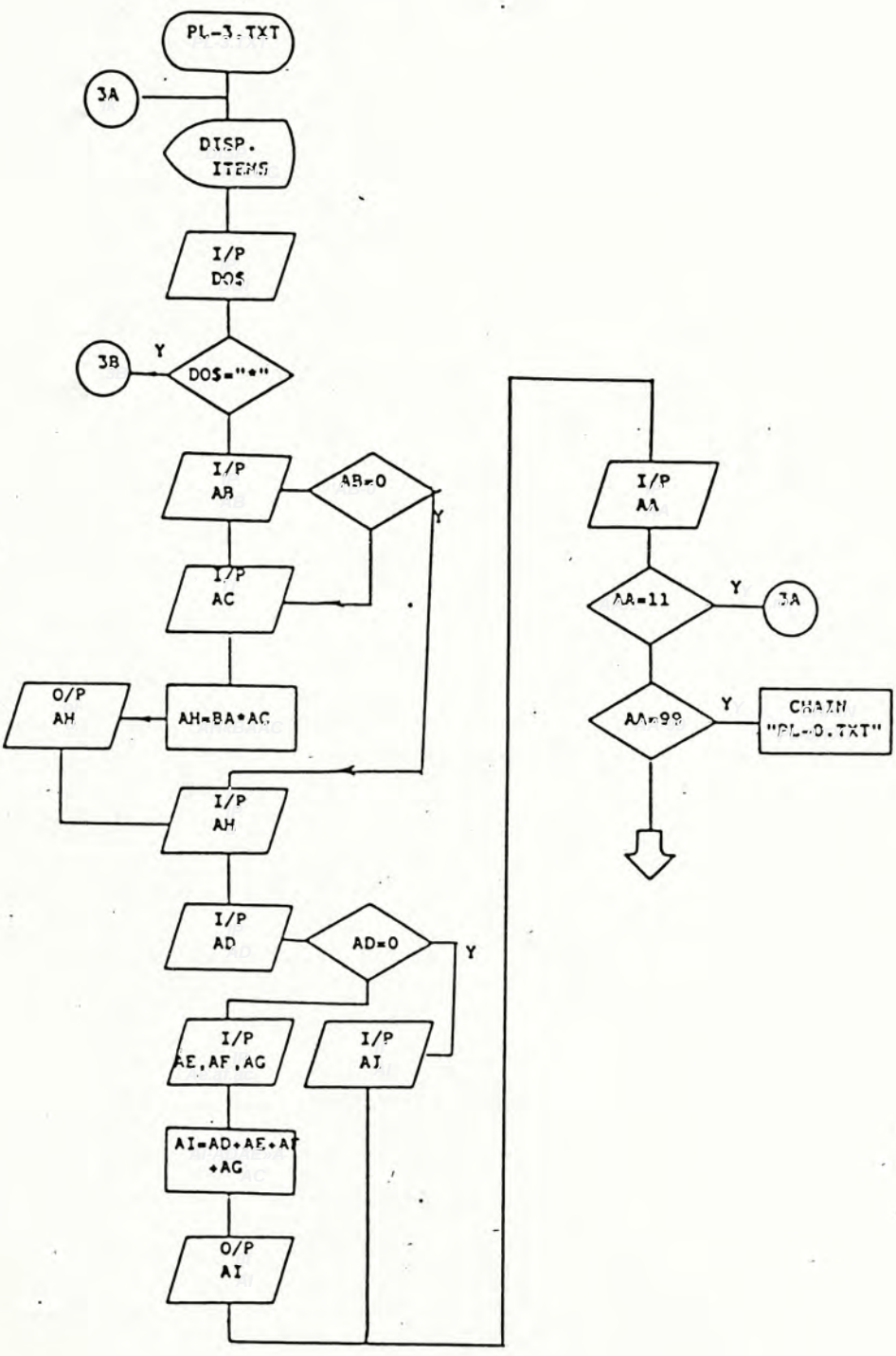


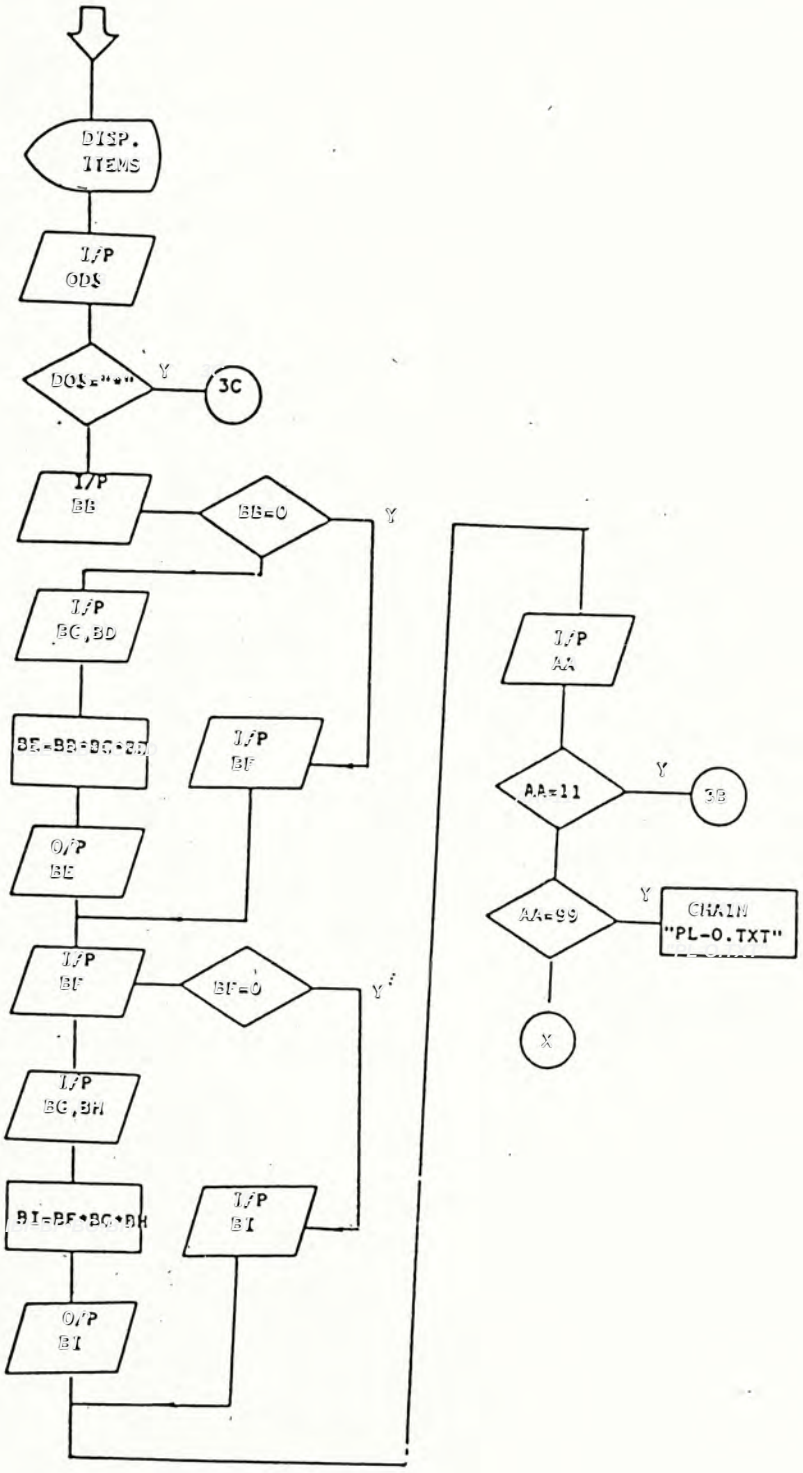


Appendix IV - B5

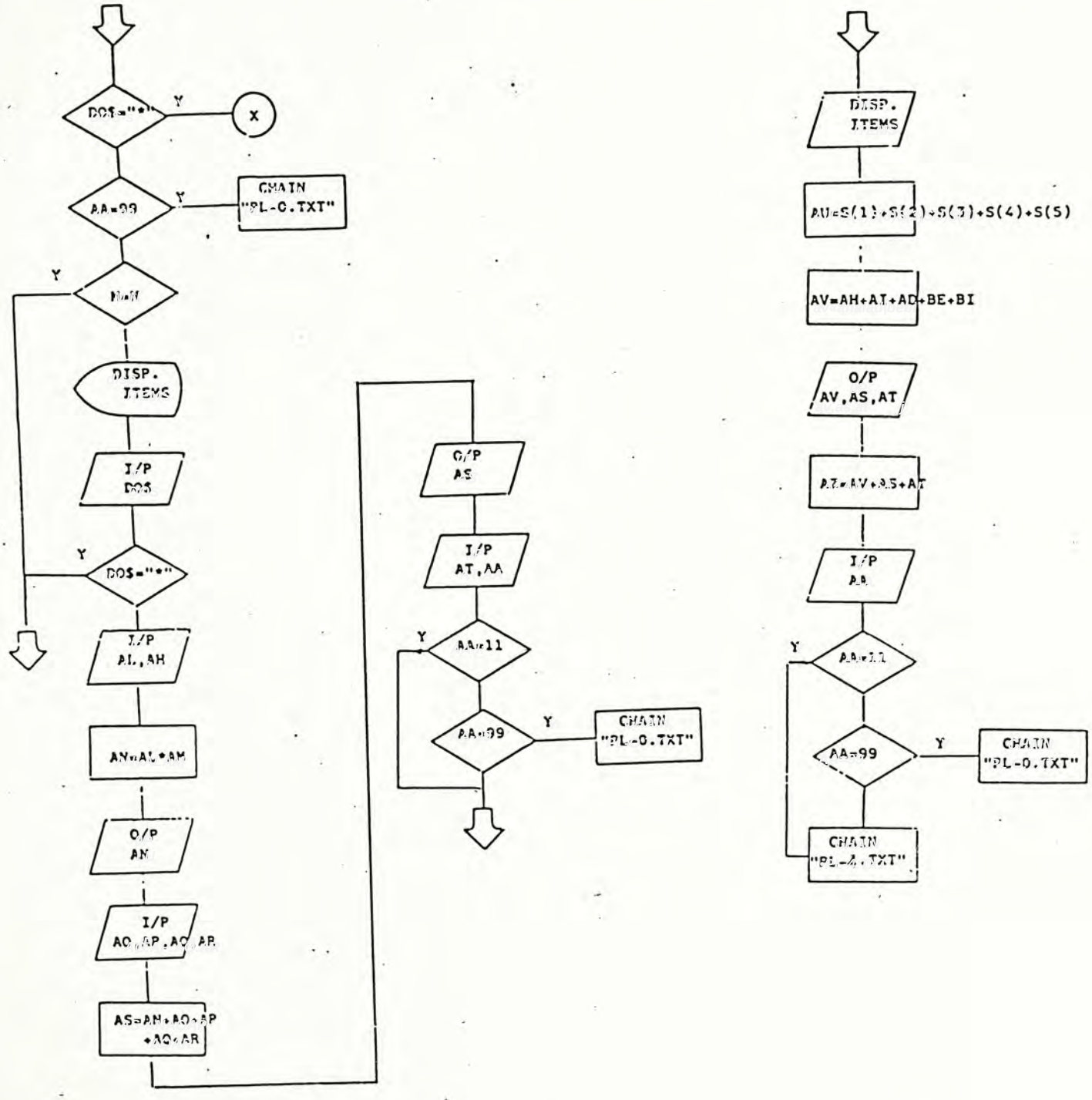


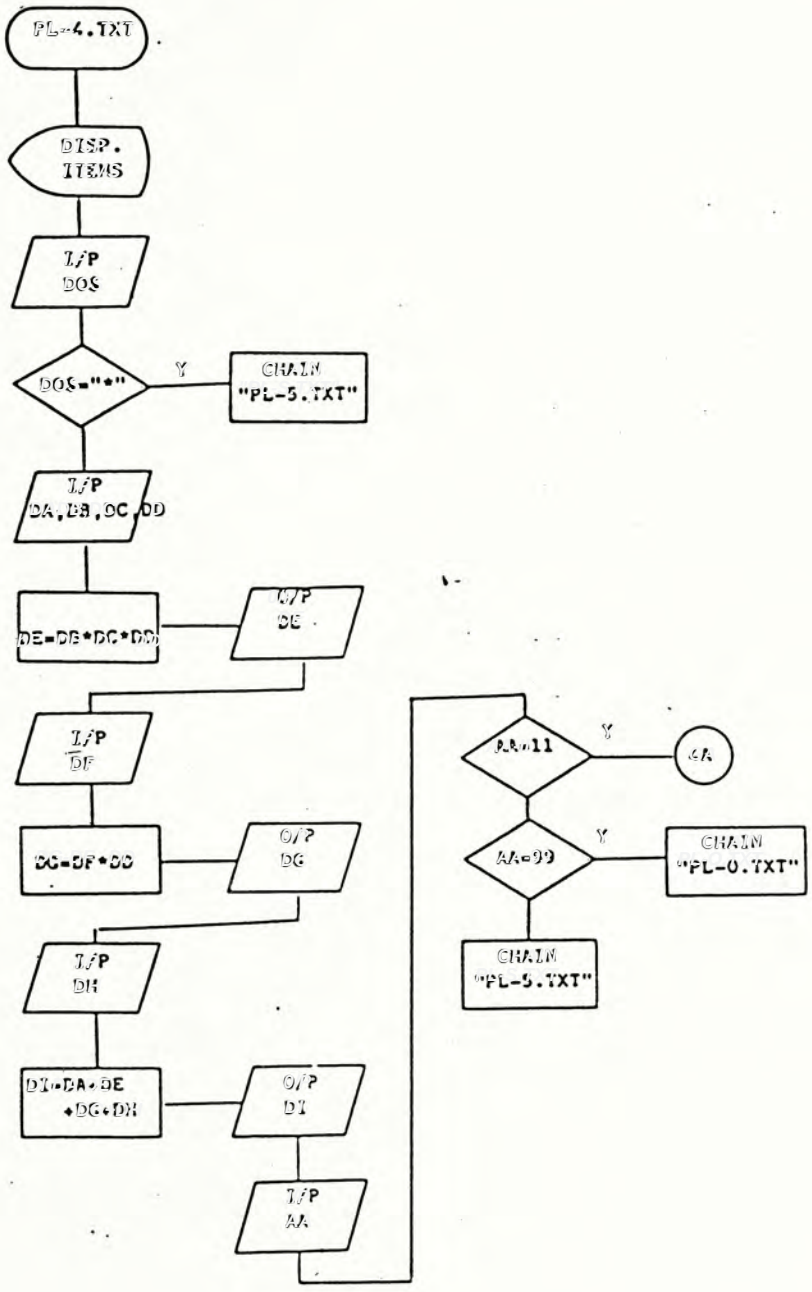

DOS="*"
Y
X
AA=99
Y
CHAIN "PL-0.TXT"
Y
N=N
DISP. ITEMS
I/P DOS
DOS="*"
Y
I/P AL, AM
AN=AL*AM
O/P AN
I/P AO, AP, AQ, AR
AS=AN+AO+AP +AQ+AR
O/P AS
I/P AT, AA
AA=11
Y
AA=99
Y
CHAIN "PL-0.TXT"
DISP. ITEMS
AV=S(1)+S(2)+S(3)+S(4)+S(5)
AV=AH+AI+AO-BE+BI
O/P AV, AS, AT
AZ=AV+AS+AT
I/P AA
AA=11
Y
AA=99
Y
CHAIN "PL-0.TXT"
CHAIN "PL-0.TXT"


PL-3.TXT
3A
DISP. ITEMS
I/P DO$
3B
Y
DO$="*"
I/P AB
AB=0
Y
I/P AC
O/P AH
AH=BA*AC
I/P AH
I/P AD
AD=0
Y
I/P AE,AF,AG
I/P AI
AI=AD+AE+AF +AG
O/P AI
I/P AA
AA=11
Y
3A
AA=99
Y
CHAIN "PL-0.TXT"

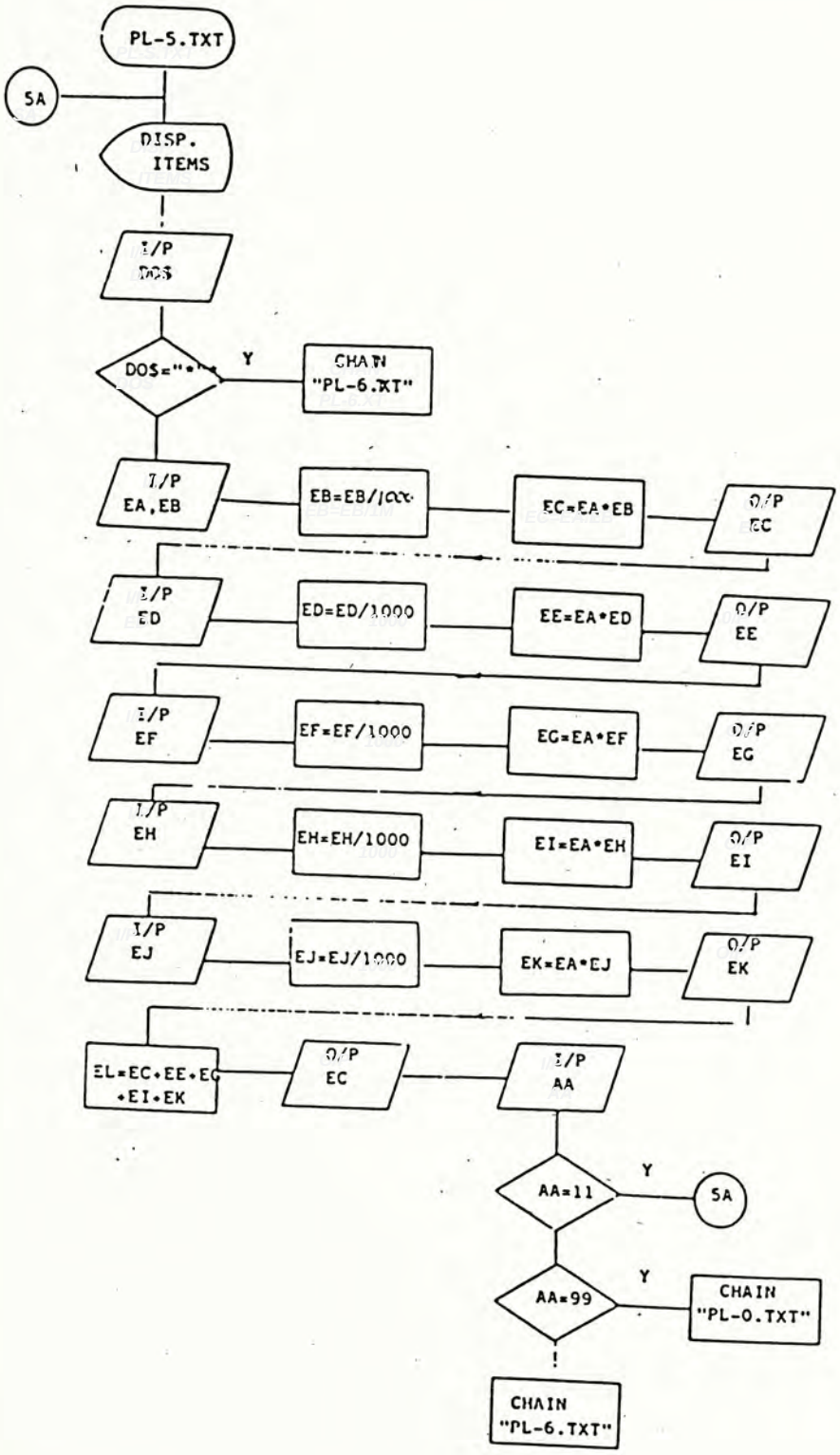

DISP.
ITEMS
I/P
OD$
OD$="*"
Y
3C
I/P
BB
BB=0
Y
I/P
BC,BD
BE=BB*BC+BD
I/P
BF
O/P
BE
I/P
BF
BF=0
Y
I/P
BG,BH
BI=BF*BG+BH
I/P
BI
O/P
BI
I/P
AA
AA=11
Y
3B
AA=99
Y
CHAIN
"PL-0.TXT"
X

Appendix IV - B9

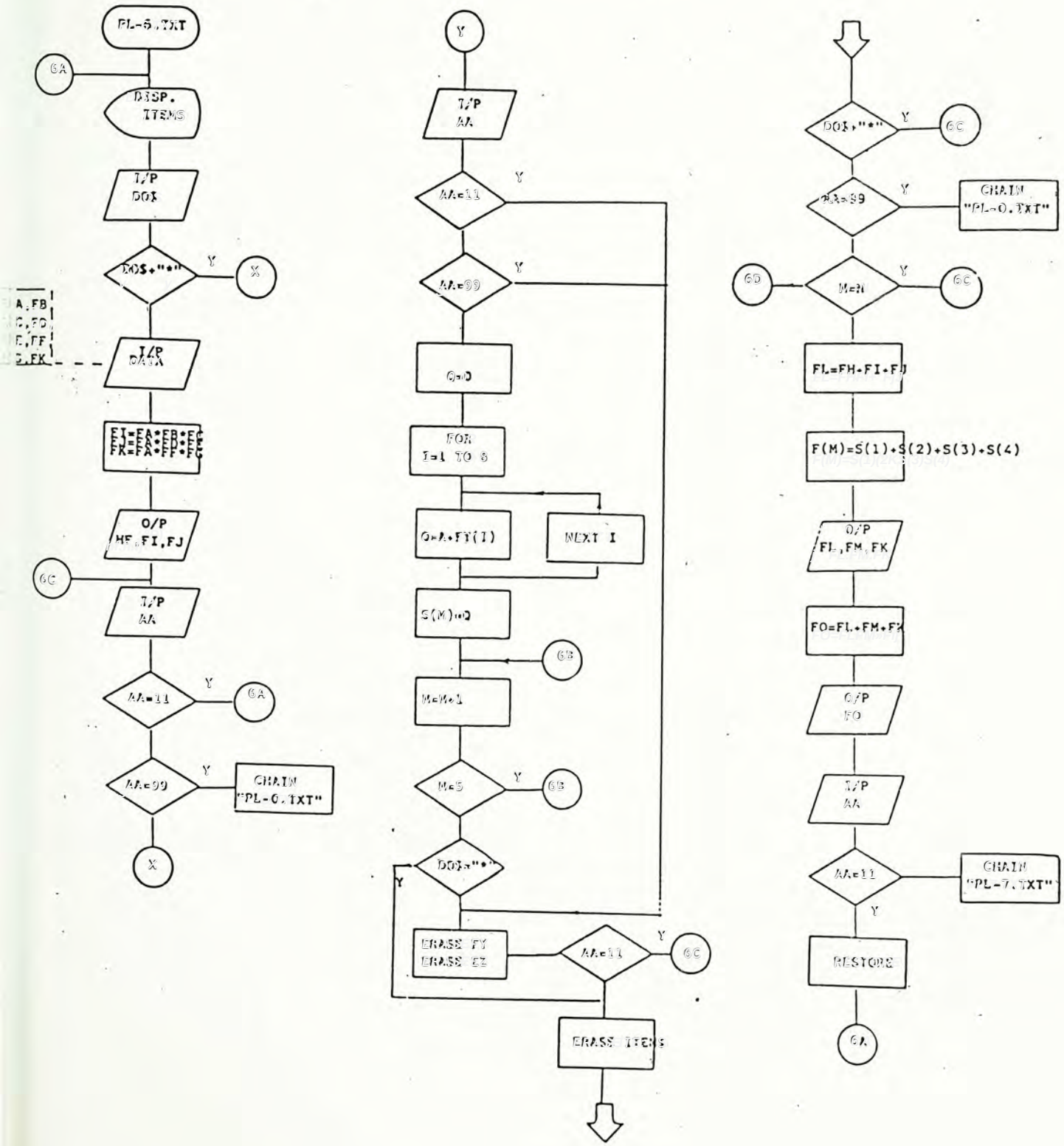


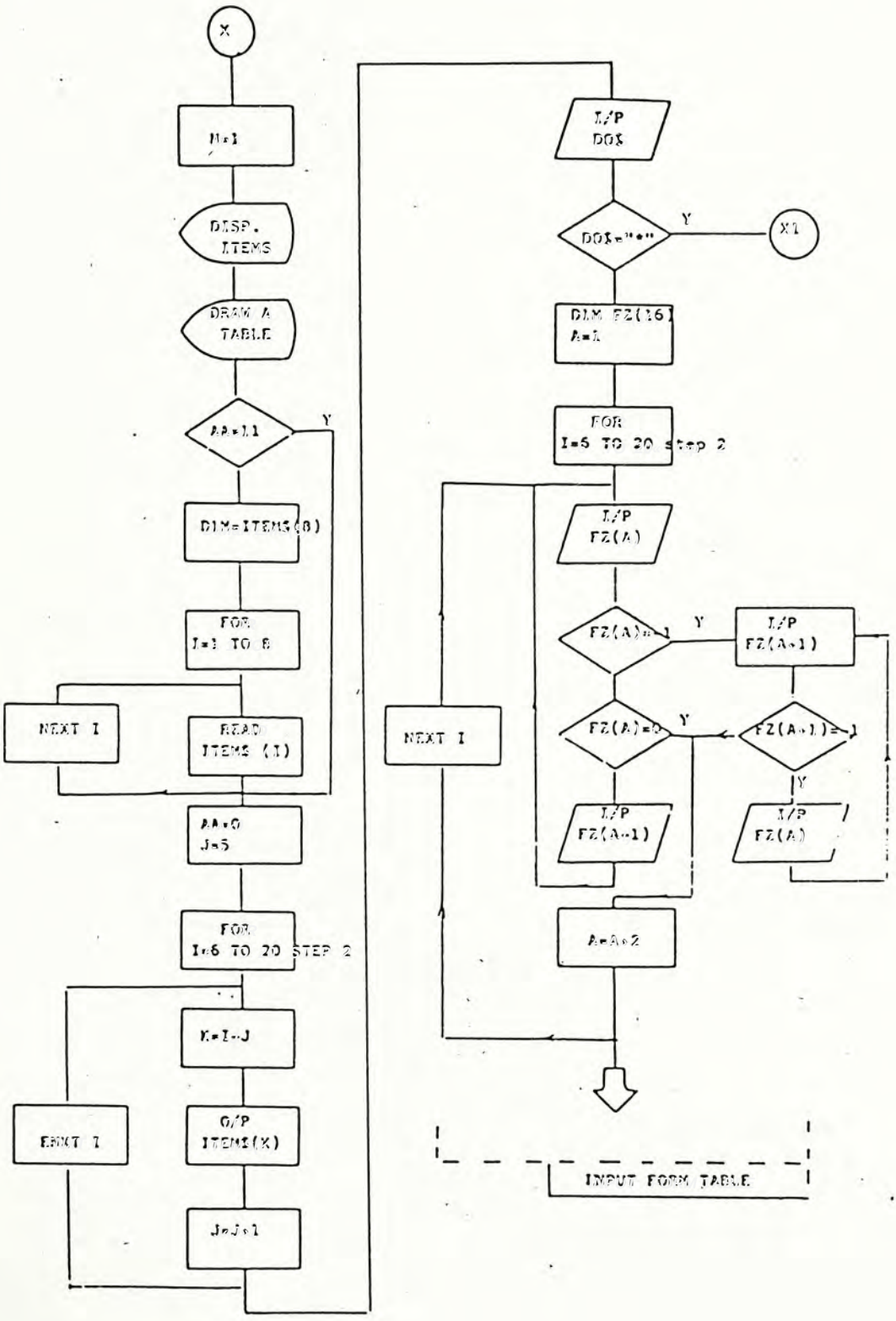

PL-4.TXT
DISP.
ITEMS
I/P
DO$
DO$="*"
Y
CHAIN
"PL-5.TXT"
I/P
DA,DB,DC,DD
DE=DB*DC*DD
O/P
DE
I/P
DF
DG=DF*DD
O/P
DG
I/P
DH
DI=DA*DE
*DG*DH
O/P
DI
I/P
AA
AA=11
Y
4A
AA=99
Y
CHAIN
"PL-0.TXT"
CHAIN
"PL-5.TXT"

Appendix IV - B11

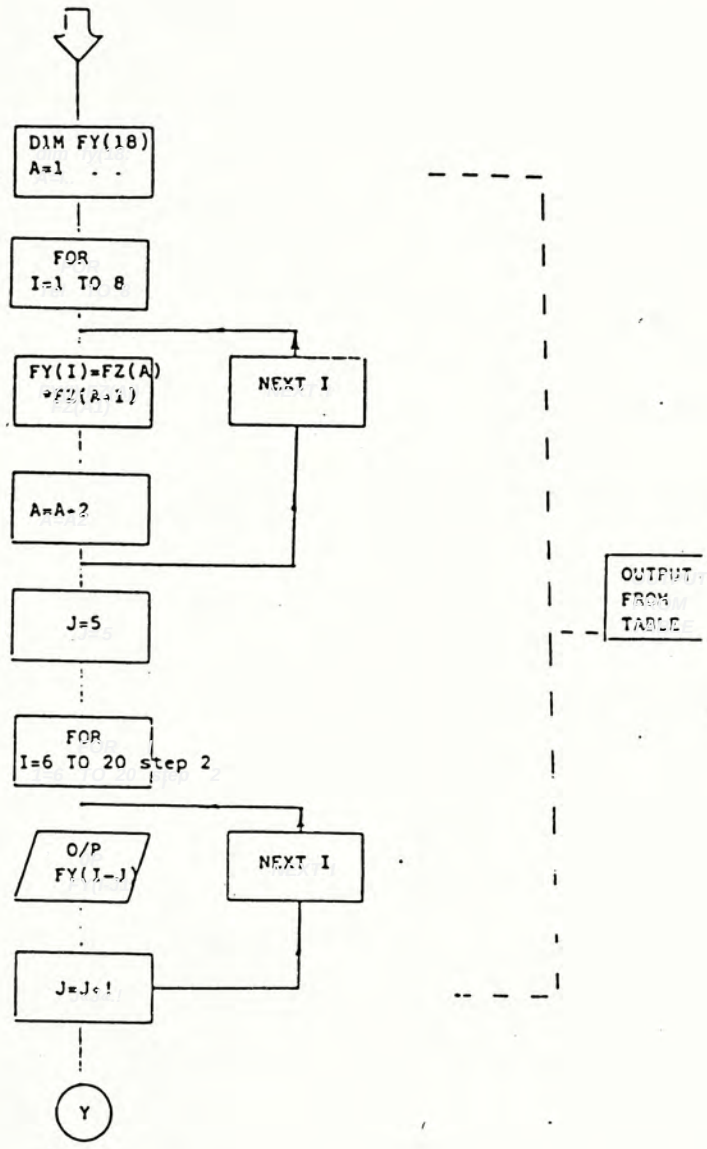


Appendix IV - B12

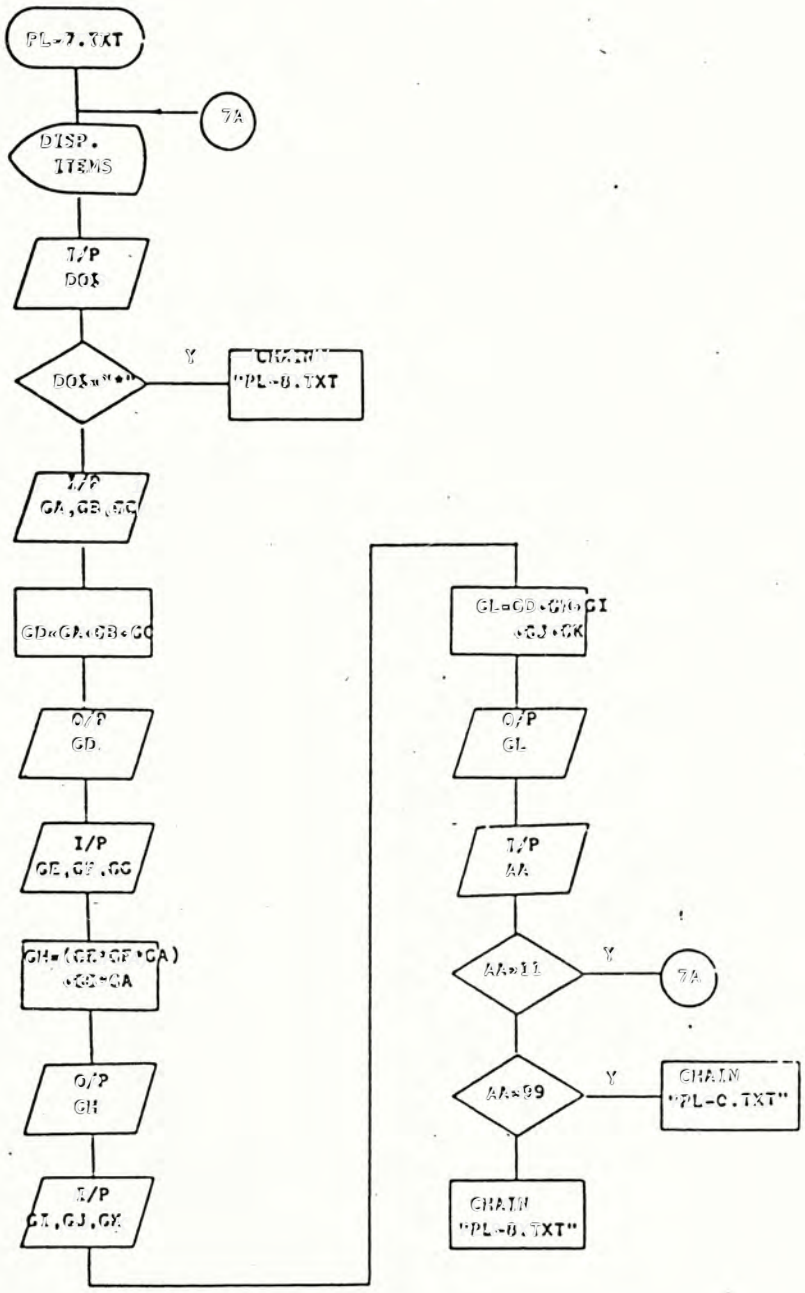



X
N=1
DISP. ITEMS
DRAW A TABLE
AA=11
Y
DIM=ITEMS(8)
FOR I=1 TO 8
NEXT I
READ ITEMS (I)
AA=0
J=5
FOR I=6 TO 20 STEP 2
K=I-J
NEXT I
O/P ITEMI(K)
J=J+1
I/P DO$
DO$="*"
Y
X1
DIM FZ(16)
A=1
FOR I=5 TO 20 step 2
I/P FZ(A)
FZ(A)=1
Y
I/P FZ(A-1)
FZ(A)=0
Y
FZ(A-1)=1
Y
I/P FZ(A-1)
I/P FZ(A)
NEXT I
A=A+2
INPUT FORM TABLE

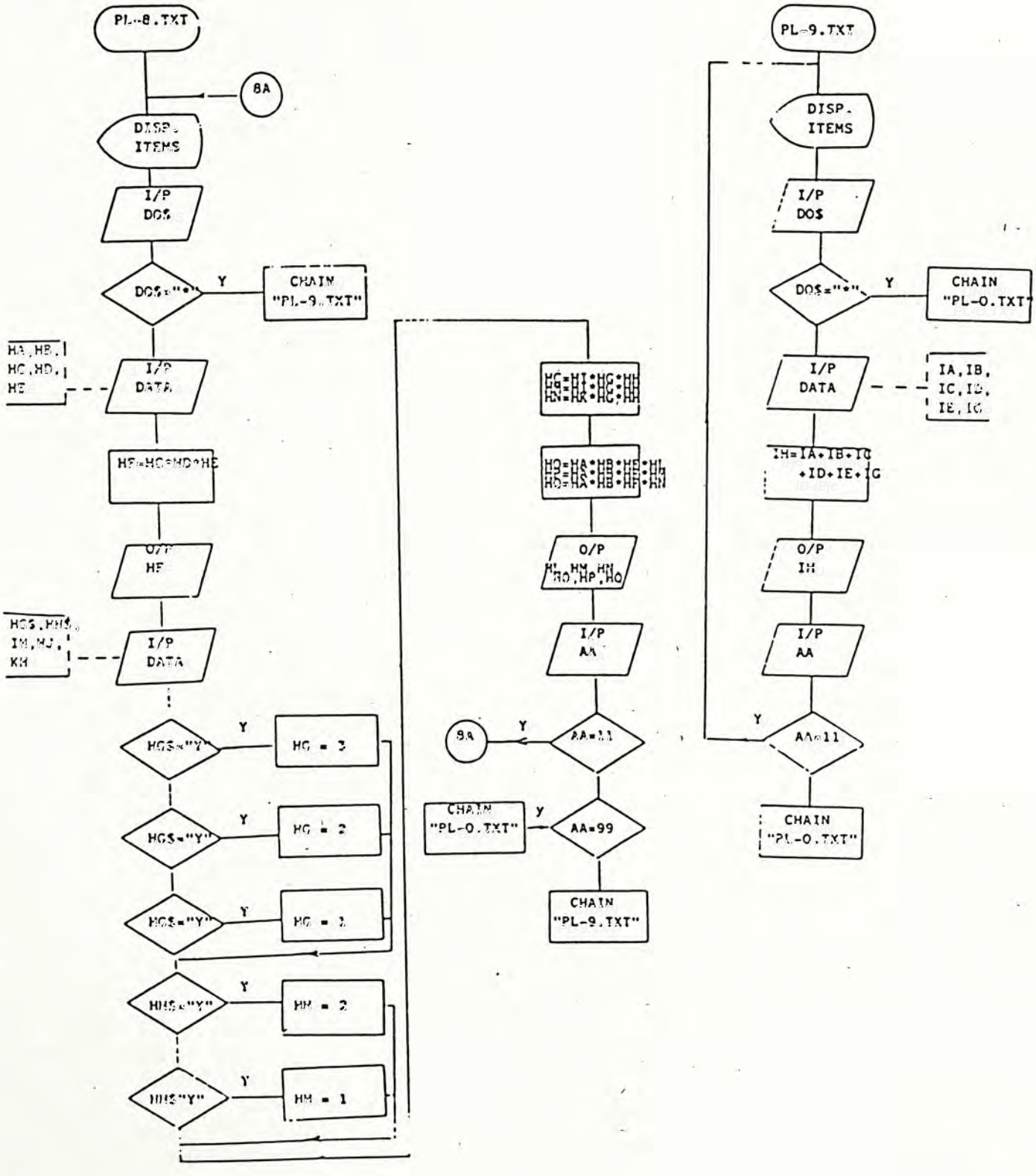
Appendix IV - B14



Appendix IV - B15



Appendix IV - B16



(C) Program

```
100 HOME : ' --- DISPLAY CHOICES ---
110 PRINT TAB(28) "* GENERNAL PRELIMINARY *" : PRINT TAB(28) "----------------------"
120 PRINT : PRINT : PRINT "## SECTIONS AVAILABLE :"
130 PRINT : PRINT TAB(20) "(1) R.E. OFFICE"
135 PRINT TAB(20) "(2) FOREMAN'S OFFICE"
140 PRINT TAB(20) "(3) CONTRACTOR'S ACCOMMODATION"
150 PRINT TAB(20) "(4) WATCHING & LIGHTING"
160 PRINT TAB(20) "(5) INSURANCE"
170 PRINT TAB(20) "(6) SETTING OUT OF WORK"
180 PRINT TAB(20) "(7) PROVIDE TRANSP. TO ENGINEER"
190 PRINT TAB(20) "(8) TRAFFIC"
200 PRINT TAB(20) "(9) MISCELLANEOUS"
210 PRINT
220 PRINT
230 PRINT
240 PRINT
250 PRINT STRING$ (78,"-")
260 PRINT "## PRESS '99' FOR EXIT"
270 PRINT "## PRESS RETURN TO START ALL SECTIONS OR SELECT ONCE"
280 PRINT TAB(60) "## CHOICE :"
290 VTAB 23 : HTAB 72 : INPUT "",CN$
300    ' --- CHECK CN$ VALUE ---
320    IF CN$="99" THEN 9000
350        ' --- SELETE PROPER PROGRAM ---
360        IF CN$="1" THEN 510
370        IF CN$="2" THEN 520
380        IF CN$="3" THEN 530
390        IF CN$="4" THEN 540
400        IF CN$="5" THEN 550
410        IF CN$="6" THEN 560
420        IF CN$="7" THEN 570
430        IF CN$="8" THEN 580
440        IF CN$="9" THEN 590
510        CHAIN "PL-1.TXT"
520        CHAIN "PL-2.TXT"
530        CHAIN "PL-3.TXT"
540        CHAIN "PL-4.TXT"
550        CHAIN "PL-5.TXT"
560        CHAIN "PL-6.TXT"
570        CHAIN "PL-7.TXT"
580        CHAIN "PL-8.TXT"
590        CHAIN "PL-9.TXT"
9000 HOME : ' END OF PRELIMINARY PROGRAM ---
9005 PRINT : PRINT : PRINT : PRINT : PRINT
9010 PRINT TAB(20) "--------------------------------"
9020 PRINT TAB(20) "*" SPC(30) "*"
9030 PRINT TAB(20) "*  END OF PRELIMINARY PROGRAM  *"
9040 PRINT TAB(20) "*" SPC(30) "*"
9050 PRINT TAB(20) "--------------------------------"
9999 END
```

```
500 HOME : ' --- R.E. OFFICE ---
510 PRINT TAB(25) "* SECTION 1 -- R.E. OFFICE *" SPC(15) "DO P.1"
513 PRINT TAB(25) "--------------------------"
520 PRINT : PRINT "(1.1) ERECTION"
530 PRINT : PRINT "(1.1.1) OFFICE ERECTION :"
540 PRINT : PRINT TAB(15) "-- AREA (IN SQ. METER) :"
550 PRINT TAB(15) "-- RATE ($/ SQ. METER) :"
555 PRINT TAB(15) "## TOTAL RATE          : $"
560 PRINT : PRINT
570 PRINT "(1.1.2) UTILITIES INSTALLATION :"
580 PRINT : PRINT TAB(15) "-- WATER SUPPLY      -- $"
590 PRINT TAB(15) "-- TELEPHONE          -- $"
600 PRINT TAB(15) "-- POWER SUPPLY       -- $"
610 PRINT TAB(15) "-- LIGHTING           -- $"
615 PRINT TAB(15) "## TOTAL INSTALLATION RATE :"
620 PRINT : PRINT
630 GOSUB 9100
640 GOSUB 9000
650 IF DO$="*" THEN 800
660 VTAB  8 : HTAB 40 : INPUT "",AB : IF AB=0 THEN 678
670 VTAB  9 : HTAB 40 : INPUT "",AC
673 AH=AB*AC
675 VTAB 10 : HTAB 41 : PRINT AH : GOTO 680
678 VTAB 10 : HTAB 42 : INPUT "",AH
680 VTAB 15 : HTAB 40 : INPUT "",AD : IF AD=0 THEN 718
690 VTAB 16 : HTAB 40 : INPUT "",AE
700 VTAB 17 : HTAB 40 : INPUT "",AF
710 VTAB 18 : HTAB 40 : INPUT "",AG
713 AI=AD+AE+AF+AG
715 VTAB 19 : HTAB 43 : PRINT AI : GOTO 720
718 VTAB 19 : HTAB 44 : INPUT "",AI
720 VTAB 23 : HTAB 70 : INPUT "",AA
730 IF AA=11 THEN 500
740 IF AA=99 THEN 2020
800   HOME : ' --- FURNITURE TABLE ---
802   M=1
804   HOME : PRINT "(1.1.3) FURNITURE :" SPC(48) "DO P.";M+1
805   GOSUB 9200
808   IF AA=11 THEN 1000
810   DIM ITEM$(8)
820   FOR I=1 TO 8
820     READ ITEM$(I)
840   NEXT I
850   DATA "COUNTER", "DESK + LOCKABLE DRAWERS", "DESK + 2 LOCKABLE DRAWERS"
860   DATA DOUBLE DESK, CONFERENCE TABLE, DESK CHAIR, CHAIR, STOOL
870   DATA LAYOUT TABLE + DRAWERS PLAN CABINET, BOOK SHELVES, FILING CABINET
880   DATA STATIONARY CUPBOARD, VERT. PLAN HOLDER TO DRG., SINK, LITTER BOX
890   DATA CORRESPONDENCE TRAY, EXT. TELEPHONE, AIR CONDITIONER
900   DATA ELECTRIC FAN HEATER, POWER SOCKETS, CALCULATOR, GAS COOKER
910   DATA FRIDGE, ELECTRIC FAN, ELECTRIC TYPEWRITER, NOTICE BOARD
920   DATA WHITE BOARD, ELECTRIC CLOCK, ELECTRIC PENCIL SHARPENER
930   DATA PHOTOCOPYING MACHINE
940   DATA A,A,A,A,A,A,A,A,A,A,
950   DATA B,B,B,B,B,B,B,B
1000          ' --- PRINT ITEM ---
1002          AA=0
1005          J=5
1010          FOR I=6 TO 20 STEP 2
1025          K=I-J
1030          VTAB I : HTAB 1 : PRINT ITEM$(K)
1040            J=J+1
```

```
1050          NEXT I
1060          GOSUB 9100
1070          GOSUB 9000
1075          LET N=M
1080          IF DO$="*" THEN 1350
1100 ' --- MANIPULATION ---
1110 GOSUB 9300
1120 GOSUB 9400
1130 GOSUB 9500
1300 VTAB 23 : HTAB 70 : INPUT "",AA
1305 IF AA=11 THEN 1360
1310 IF AA=99 THEN 1360
1315 Q=0 : FOR I=1 TO 8
1320          Q=Q+FY(I)
1325        NEXT I
1327        S(M)=Q
1350 M=M+1
1353 IF M=6 THEN 1500
1355 IF DO$="*" THEN 1370
1360 ERASE FY : ERASE FZ
1365 IF AA=11 THEN 804
1370 ERASE ITEM$
1375 IF DO$="*" THEN 804
1380 IF AA=99 THEN 2020
1385 IF M=N THEN 1390 ELSE 804
1390 GOTO 1350
1500    HOME : ' --- 1.2 & 1.3 ---
1505    PRINT TAB(68) "DO P.8"
1510    PRINT "(1.2) SERVICE/MAINTENANCE"
1520    PRINT : PRINT TAB(10) "-- FEMALE LABOURER"
1530    PRINT TAB(20) "- NUMBER REQUIRE :"
1540    PRINT TAB(20) "- MONTHLY SALARY :"
1545    PRINT TAB(50) "$/MONTH :"
1550    PRINT : PRINT TAB(10) "-- FOOD AND BEVERAGE" SPC(20) "$/MONTH :"
1560    PRINT : PRINT TAB(10) "-- WATER CONSUMPTION" SPC(20) "$/MONTH :"
1570    PRINT : PRINT TAB(10) "-- POWER CONSUMPTION" SPC(20) "$/MONTH :"
1580    PRINT : PRINT TAB(10) "-- TELEPHONE SERVICE" SPC(20) "$/MONTH :"
1585   PRINT : PRINT TAB(10) "-- CONTRACT DURATION" SPC(19) "IN MONTH :"
1590    PRINT : PRINT : PRINT "(1.3) DISMANTLING" SPC(32) "$/ITEM  :"
1610    GOSUB 9100
1620    GOSUB 9000
1640    IF DO$="*" THEN 1800
1650    ' --- I/P DATA ---
1660    VTAB 5 : HTAB 39 : INPUT "",AL
1670    VTAB 6 : HTAB 39 : INPUT "",AM
1675    AN=AL*AM
1680    VTAB 7 : HTAB 59 : PRINT AN
1690    VTAB  9 : HTAB 60 : INPUT "",AO
1700    VTAB 11 : HTAB 60 : INPUT "",AP
1710    VTAB 13 : HTAB 60 : INPUT "",AQ
1720    VTAB 15 : HTAB 60 : INPUT "",AR
1725   VTAB 17 : HTAB 60 : INPUT "",AM
1730    AS=AN+AO+AP+AQ+AR
1740    VTAB 17 : HTAB 41 : PRINT "## TOTAL $/MONTH :";AS
1750    VTAB 20 : HTAB 60 : INPUT "",AT
1760    VTAB 23 : HTAB 70 : INPUT "",AA
1770    IF AA=11 THEN 1500
1780    IF AA=99 THEN 2020
1800       HOME : ' --- SECTION 1 SUMMARY ---
1810       PRINT : PRINT TAB(20) "* SUMMARY ON SECTION (1) -- R.E. OFFICE *"
1820       PRINT TAB(20) "-----------------------------------"
```

```
1830       PRINT : PRINT : AU=S(1)+S(2)+S(3)+S(4)+S(5)
1835       AV=AH+AI+AU
1840       PRINT : PRINT TAB(10) "## RATE ON ERECTION            --------- $";AV
1850       PRINT : PRINT TAB(10) "## RATE ON SERVICE/MAINTENANCE --------- $";AS*AW
1860       PRINT : PRINT TAB(10) "## RATE ON DISMANTLING         --------- $";AT
1870       PRINT : PRINT TAB(10) STRING$ (60,".")
1875       AZ=AV+AS*AH+AT
1880       PRINT : PRINT TAB(29) "## TOTAL RATE ------- $";AZ
1890       GOSUB 9100
1895       VTAB 23 : HTAB 70 : INPUT "",AA
1900       IF AA=11 THEN 2010
1910       IF AA=99 THEN 2020
1895       VTAB 23 : HTAB 70 : INPUT "",AA
1900       IF AA=11 THEN 2010
1910       IF AA=99 THEN 2020
2000 ' --- SELETE PROPER PROGRAM ---
2010 CHAIN "PL-2.TXT"
2020 CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130   RETURN
9200       ' --- DRAW A TABLE ---
9210       VTAB 3 : HTAB 1 : PRINT STRING$ (78,"-")
9220       PRINT TAB(15) "ITEM" SPC(25) "NO." SPC(8) "$/NO." SPC(8) "TOTAL"
9230       FOR I=5 TO 21 STEP 2
9240         VTAB I : HTAB 1 : PRINT STRING$ (78,"-")
9250       NEXT I
9260       RETURN
9300 ' --- I/P DATA FROM TABLE ---
9310 DIM FZ(16)
9320 A=1
9330 FOR I=6 TO 20 STEP 2
9340   VTAB I : HTAB 44 : INPUT "",FZ(A)
9343   IF FZ(A)=-1 THEN 9345 ELSE 9350
9344    IF FZ(A)=0 THEN 9360 ELSE 9345
9345   VTAB I-2 : HTAB 57 : INPUT "",FZ(A-1)
9347   GOTO 9340
9350   VTAB I : HTAB 57 : INPUT "",FZ(A+1)
9353   IF FZ(A+1)=-1 THEN 9355 ELSE 9360
9355   VTAB I : HTAB 44 : INPUT "",FZ(A)
9357   GOTO 9350
9360   A=A+2
9370 NEXT I
9380 RETURN
9400    ' --- PROCESSING FROM TABLE ---
9410    DIM FY(8)
9420    A=1
9430    FOR I=1 TO 8
9440      FY(I)=FZ(A)*FZ(A+1)
9450      A=A+2
9460    NEXT I
9470    RETURN
9500       ' --- O/P DATA TO TABLE ---
9510       J=5
9520       FOR I=6 TO 20 STEP 2
9530         VTAB I : HTAB 67 : PRINT FY(I-J)
9540         J=J+1
9550       NEXT I
9560       RETURN
```

Appendix IV - C5

```
500 HOME : ' --- FOREMAN'S OFFICE ---
510 PRINT TAB(22) "* SECTION 2 -- FOREMAN'S OFFICE *" SPC(13) "DO P.1"
513 PRINT TAB(22) "--------------------------------"
520 PRINT : PRINT "(2.1) ERECTION"
530 PRINT : PRINT "(2.1.1) OFFICE ERECTION :"
540 PRINT : PRINT TAB(15) "-- AREA (IN SQ. METER) :"
550 PRINT TAB(15) "-- RATE ($/ SQ. METER) :"
555 PRINT TAB(15) "## TOTAL RATE          : $"
560 PRINT : PRINT
570 PRINT "(2.1.2) UTILITIES INSTALLATION :"
580 PRINT : PRINT TAB(15) "-- WATER SUPPLY     -- $"
590 PRINT TAB(15) "-- TELEPHONE        -- $"
600 PRINT TAB(15) "-- POWER SUPPLY     -- $"
610 PRINT TAB(15) "-- LIGHTING         -- $"
615 PRINT TAB(15) "## TOTAL INSTALLATION RATE :"
620 PRINT : PRINT
630 GOSUB 9100
640 GOSUB 9000
650 IF QQ$="" THEN 800
660 VTAB  8 : HTAB 40 : INPUT "",AB : IF AB=0 THEN 678
670 VTAB  9 : HTAB 40 : INPUT "",AC
673 AH=AB*AC
675 VTAB 10 : HTAB 41 : PRINT AH : GOTO 680
678 VTAB 10 : HTAB 42 : INPUT "",AH
680 VTAB 15 : HTAB 40 : INPUT "",AD : IF AD=0 THEN 718
690 VTAB 16 : HTAB 40 : INPUT "",AE
700 VTAB 17 : HTAB 40 : INPUT "",AF
710 VTAB 18 : HTAB 40 : INPUT "",AG
713 AI=AD+AE+AF+AG
715 VTAB 19 : HTAB 43 : PRINT AI : GOTO 720
718 VTAB 19 : HTAB 44 : INPUT "",AI
720 VTAB 23 : HTAB 70 : INPUT "",AA
730 IF AA=11 THEN 500
740 IF AA=99 THEN 2020
800   HOME : ' --- FURNITURE TABLE ---
802   M=1
804   HOME : PRINT "(2.1.3) FURNITURE :" SPC(48) "DO P.";M+1
806   GOSUB 9200
808   IF AA=11 THEN 1000
810   DIM ITEM$(8)
820   FOR I=1 TO 8
830     READ ITEM$(I)
840   NEXT I
850 DATA DESK, DESK CHAIR, STOOL, STORAGE CABINET, PLAN HANGER UNIT
860 DATA LAYOUT TABLE, AIR CONDITIONER, TELEPHONE, POWER POINT
870 DATA WATER CLOSET, WASH BASIN, ELECTRIC KETTLE, CUPS & SAUCERS
880 DATA SPOONS, DRINKING GLASS, REFRIGERATOR, FIRE EXTINGUISHER
890 DATA FIRST AID CABINET, SOFT BOARD NOTICE BOARD
900 DATA WHYTE BOARD NOTICE BOARD, BURGLAR BARS TO ALL WINDOWS
910 DATA FLYMESH SCREEN TO ALL WINDOWS & DOORS, TYPHOON GUY ROPES TO ROOF
920 DATA WATER STORAGE TANK, WATER HEATER
930 DATA E,E,E,E,E,E,E,F,F,F,F,F,F,F
940 DATA G,G,G,G,G,G,G,G
950 DATA H,H,H,H,H,H,H,H
```

```
1000          ' --- PRINT ITEM ---
1002          AA=0
1005          J=5
1010          FOR I=6 TO 20 STEP 2
1025          K=I-J
1030          VTAB I : HTAB 1 : PRINT ITEM$(K)
1040            J=J+1
1050          NEXT I
1060          GOSUB 9100
1070          GOSUB 9000
1075          LET N=M
1080          IF DO$="*" THEN 1350
1100 ' --- MANIPULATION ---
1110 GOSUB 9300
1120 GOSUB 9400
1130 GOSUB 9500
1300 VTAB 23 : HTAB 70 : INPUT "",AA
1305 IF AA=11 THEN 1360
1310 IF AA=99 THEN 1360
1315 Q=0 : FOR I=1 TO 8
1320         Q=Q+FY(I)
1325       NEXT I
1327       S(M)=Q
1350 M=M+1
1353 IF M=6 THEN 1500
1355 IF DO$="*" THEN 1370
1360 ERASE FY : ERASE FZ
1365 IF AA=11 THEN 804
1370 ERASE ITEM$
1375 IF DO$="*" THEN 804
1380 IF AA=99 THEN 2020
1385 IF M=N THEN 1390 ELSE 804
1390 GOTO 1350
1500   HOME : ' --- 2.2 & 2.3 ---
1505   PRINT TAB(68) "DO P.8"
1510   PRINT "(2.2) SERVICE/MAINTENANCE"
1520   PRINT : PRINT TAB(10) "-- FEMALE LABOURER"
1530   PRINT TAB(20) "- NUMBER REQUIRE :"
1540   PRINT TAB(20) "- MONTHLY SALARY :"
1545   PRINT TAB(50) "$/MONTH :"
1550   PRINT : PRINT TAB(10) "-- FOOD AND BEVERAGE" SPC(20) "$/MONTH :"
1560   PRINT : PRINT TAB(10) "-- WATER CONSUMPTION" SPC(20) "$/MONTH :"
1570   PRINT : PRINT TAB(10) "-- POWER CONSUMPTION" SPC(20) "$/MONTH :"
1580   PRINT : PRINT TAB(10) "-- TELEPHONE SERVICE" SPC(20) "$/MONTH :"
1585   PRINT : PRINT TAB(10) "-- CONTRACT DURATION" SPC(19) "IN MONTH :"
1590   PRINT : PRINT : PRINT "(2.3) DISMANTLING" SPC(32) "$/ITEM  :"
1610   GOSUB 9100
1620   GOSUB 9000
1640   IF DO$="*" THEN 1800
1650   ' --- I/P DATA ---
1660   VTAB 5 : HTAB 39 : INPUT "",AL
1670   VTAB 6 : HTAB 39 : INPUT "",AM
1675   AN=AL*AM
1680   VTAB 7 : HTAB 59 : PRINT AN
1690   VTAB  9 : HTAB 60 : INPUT "",AO
1700   VTAB 11 : HTAB 60 : INPUT "",AP
1710   VTAB 13 : HTAB 60 : INPUT ""       AZ=AV+AS*AW+AT
1880      PRINT : PRINT TAB(29) "## TOTAL RATE ------- $";AZ
```

```
1890        GOSUB 9100
1895        VTAB 23 : HTAB 70 : INPUT "",AA
1900        IF AA=11 THEN 2020
1910        IF AA=99 THEN 2020
2000 ' --- SELETE PROPER PROGRAM ---
2010 CHAIN "PL-3.TXT"
2020 CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100     ' --- ASK FOR CONT ---
9110     VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
9120     PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130   RETURN
9200        ' --- DRAW A TABLE ---
9210        VTAB 3 : HTAB 1 : PRINT STRING$ (78,"-")
9220        PRINT TAB(15) "ITEM" SPC(25) "NO." SPC(8) "$/NO." SPC(8) "TOTAL"
9230        FOR I=5 TO 21 STEP 2
9240          VTAB I : HTAB 1 : PRINT STRING$ (78,"-")
9250        NEXT I
9260        RETURN
9300 ' --- I/P DATA FROM TABLE ---
9310 DIM FZ(16)
9320 A=1
9330 FOR I=6 TO 20 STEP 2
9340   VTAB I : HTAB 44 : INPUT "",FZ(A)
9343   IF FZ(A)=-1 THEN 9345 ELSE 9350
9344    IF FZ(A)=0 THEN 9360 ELSE 9345
9345   VTAB I-2 : HTAB 57 : INPUT "",FZ(A-1)
9347   GOTO 9340
9350   VTAB I : HTAB 57 : INPUT "",FZ(A+1)
9353   IF FZ(A+1)=-1 THEN 9355 ELSE 9360
9355   VTAB I : HTAB 44 : INPUT "",FZ(A)
9357   GOTO 9350
9360   A=A+2
9370 NEXT I
9380 RETURN
9400     ' --- PROCESSING FROM TABLE ---
9410     DIM FY(8)
9420     A=1
9430     FOR I=1 TO 8
9440       FY(I)=FZ(A)*FZ(A+1)
9450       A=A+2
9460     NEXT I
9470     RETURN
9500        ' --- O/P DATA TO TABLE ---
9510        J=5
9520        FOR I=6 TO 20 STEP 2
9530          VTAB I : HTAB 67 : PRINT FY(I-J)
9540          J=J+1
9550        NEXT I
9560        RETURN
```

```
100 HOME : ' --- CONTRACTOR'S ACCOMMODATION ---
110 PRINT TAB(20) "* SECTION 3 -- CONTRACTOR'S ACCOMMODATION *" SPC(6) "DO P.1"
120 PRINT TAB(20) STRING$ (43,"-")
130 PRINT : PRINT "(3.1) ERECTION"
140 PRINT : PRINT "(3.1.1) OFFICE ERECTION :"
150 PRINT : PRINT TAB(15) "-- AREA (IN SQ. METER) :"
160 PRINT TAB(15) "-- RATE  ($/SQ. METER) :"
170 PRINT TAB(15) "## TOTAL RATE          : $"
180 PRINT : PRINT
190 PRINT "(3.1.2) UTILITIES INSTALLATION :"
200 PRINT : PRINT TAB(15) "-- WATER SUPPLY     -- $"
210 PRINT TAB(15) "-- TELEPHONE          -- $"
220 PRINT TAB(15) "-- POWER SUPPLY       -- $"
230 PRINT TAB(15) "-- LIGHTING           -- $"
240 PRINT TAB(15) "## TOTAL INSTALLATION RATE : $"
250 GOSUB 9100
260 GOSUB 9000
270 IF DO$="*" THEN 400
280 VTAB  8 : HTAB 40 : INPUT "",AB : IF AB=0 THEN 310
290 VTAB  9 : HTAB 40 : INPUT "",AC
300 AH=AB*AC
305 VTAB 10 : HTAB 41 : PRINT AH : GOTO 315
310 VTAB 10 : HTAB 42 : INPUT "",AH
315 VTAB 15 : HTAB 40 : INPUT "",AD : IF AD=0 THEN 345
320 VTAB 16 : HTAB 40 : INPUT "",AE
325 VTAB 17 : HTAB 40 : INPUT "",AF
330 VTAB 18 : HTAB 40 : INPUT "",AG
335 AI=AD+AE+AF+AG
340 VTAB 19 : HTAB 46 : PRINT AI : GOTO 350
345 VTAB 19 : HTAB 46 : INPUT "",AI
350 VTAB 23 : HTAB 70 : INPUT "",AA
355 IF AA=11 THEN 100
360 IF AA=99 THEN 2020
400 HOME : ' --- WORKSHOP & CANTEEN ---
410 PRINT TAB(68) "DO P.2"
420 PRINT : PRINT "(3.1.3) WORKSHOP :"
430 PRINT : PRINT TAB(15) "-- AREA (IN SQ. METER) :"
440 PRINT TAB(15) "-- RATE  ($/SQ. METER) : $"
450 PRINT TAB(15) "-- EQUIPMENT  ($/ITEM) : $"
460 PRINT TAB(15) "## TOTAL RATE          : $"
470 PRINT : PRINT
480 PRINT "(3.1.4) CANTEEN :"
490 PRINT : PRINT TAB(15) "-- AREA (IN SQ. METER) :"
500 PRINT TAB(15) "-- RATE  ($/SQ. METER) : $"
510 PRINT TAB(15) "-- PROVISION  ($/ITEM) : $"
520 PRINT TAB(15) "## TOTAL RATE          : $"
530 GOSUB 9100
540 GOSUB 9000
550 IF DO$="*" THEN 800
560 ' --- I/P DATA ---
570 VTAB 5 : HTAB 40 : INPUT "",BB : IF BB=0 THEN 620
580 VTAB 6 : HTAB 42 : INPUT "",BC
590 VTAB 7 : HTAB 42 : INPUT "",BD
600 BE=BB*BC+BD
610 VTAB 8 : HTAB 41 : PRINT BE : GOTO 625
620 VTAB 8 : HTAB 42 : INPUT "",BE
625 VTAB 13 : HTAB 40 : INPUT "",BF : IF BF=0 THEN 650
630 VTAB 14 : HTAB 42 : INPUT "",BG
635 VTAB 15 : HTAB 42 : INPUT "",BH
640 BI=BF*BG+BH
```

```
645 VTAB 16 : HTAB 41 : PRINT BI : GOTO 655
650 VTAB 16 : HTAB 42 : INPUT "
880     DATA STATIONARY CUPBOARD, VERT. PLAN HOLDER TO DRG., SINK, LITTER BOX
890     DATA CORRESPONDENCE TRAY, EXT. TELEPHONE, AIR CONDITIONER
900     DATA ELECTRIC FAN HEATER, POWER SOCKETS, CALCULATOR, GAS COOKER
910     DATA FRIDGE, ELECTRIC FAN, ELECTRIC TYPEWRITER, NOTICE BOARD
920     DATA WHITE BOARD, ELECTRIC CLOCK, ELECTRIC PENCIL SHAPENER
930     DATA PHOTOCOPYING MACHINE
940     DATA A,A,A,A,A,A,A,A,A,A,
950     DATA B,B,B,B,B,B,B,B
1000          ' --- PRINT ITEM ---
1002          AA=0
1005          J=5
1010          FOR I=6 TO 20 STEP 2
1025          K=I-J
1030          VTAB I : HTAB 1 : PRINT ITEM$(K)
1040            J=J+1
1050          NEXT I
1060          GOSUB 9100
1070          GOSUB 9000
1075          LET N=M
1080          IF DO$="*" THEN 1350
1100 ' --- MANIPULATION ---
1110 GOSUB 9300
1120 GOSUB 9400
1130 GOSUB 9500
1300 VTAB 23 : HTAB 70 : INPUT "",AA
1305 IF AA=11 THEN 1360
1310 IF AA=99 THEN 1360
1315 Q=0 : FOR I=1 TO 8
1320          Q=Q+FY(I)
1325        NEXT I
1327        S(M)=Q
1350 M=M+1
1353 IF M=6 THEN 1500
1355 IF DO$="*" THEN 1370
1360 ERASE FY : ERASE FZ
1365 IF AA=11 THEN 804
1370 ERASE ITEM$
1375 IF DO$="*" THEN 804
1380 IF AA=99 THEN 2020
1385 IF M=N THEN 1390 ELSE 804
1390 GOTO 1350
1500     HOME : ' --- 3.2 & 3.3 ---
1505     PRINT TAB(68) "DO P.9"
1510     PRINT "(3.2) SERVICE/MAINTENANCE"
1520     PRINT : PRINT TAB(10) "-- FEMALE LABOURER"
1530     PRINT TAB(20) "- NUMBER REQUIRE :"
1540     PRINT TAB(20) "- MONTHLY SALARY :"
1545     PRINT TAB(50) "$/MONTH :"
1550     PRINT : PRINT TAB(10) "-- FOOD AND BEVERAGE" SPC(20) "$/MONTH :"
1560     PRINT : PRINT TAB(10) "-- WATER CONSUMPTION" SPC(20) "$/MONTH :"
1570     PRINT : PRINT TAB(10) "-- POWER CONSUMPTION" SPC(20) "$/MONTH :"
1580     PRINT : PRINT TAB(10) "-- TELEPHONE SERVICE" SPC(20) "$/MONTH :"
1585     PRINT : PRINT TAB(10) "-- CONTRACT DURATION" SPC(19) "IN MONTH :"
1590     PRINT : PRINT : PRINT "(1.3) DISMANTLING" SPC(32) "$/ITEM  :"
1610     GOSUB 9100
1620     GOSUB 9000
1640     IF DO$="*" THEN 1800
1650     ' --- I/P DATA ---
1660     VTAB 5 : HTAB 39 : INPUT "",AL
1670     VTAB 6 : HTAB 39 : INPUT "",AM
1675     AN=AL*AM
```

```
1680    VTAB 7 : HTAB 59 : PRINT AN
1690    VTAB  9 : HTAB 60 : INPUT "",AO
1700    VTAB 11 : HTAB 60 : INPUT "",AP
1710    VTAB 13 : HTAB 60 : INPUT "",AQ
1720    VTAB 15 : HTAB 60 : INPUT "",AR
1725    VTAB 17 : HTAB 60 : INPUT "",AW
1730    AS=AN+AO+AP+AQ+AR
1740    VTAB 17 : HTAB 41 : PRINT "## TOTAL $/MONTH :";AS
1750    VTAB 20 : HTAB 60 : INPUT "",AT
1760    VTAB 23 : HTAB 70 : INPUT "",AA
1770    IF AA=11 THEN 1500
1780    IF AA=99 THEN 2020
1800       HOME : ' --- SECTION 3 SUMMARY ---
1810       PRINT : PRINT TAB(16) "* SUMMARY ON SECTION (2) -- CONTRACTOR'S OFFICE *"
1820       PRINT TAB(16) STRING$ (49,"-")
1830       PRINT : PRINT : AU=S(1)+S(2)+S(3)+S(4)+S(5)
1835       AV=AR+AI+AU+BE+BI
1840       PRINT : PRINT TAB(10) "## RATE ON ERECTION              --------- $";AV
1850       PRINT : PRINT TAB(10) "## RATE ON SERVICE/MAINTENANCE --------- $";AS*AW
1860       PRINT : PRINT TAB(10) "## RATE ON DISMANTLING          --------- $";AT
1870       PRINT : PRINT TAB(10) STRING$ (60,".")
1875       AZ=AV+AS*AW+AT
1880       PRINT : PRINT TAB(29) "## TOTAL RATE ------- $";AZ
1890       GOSUB 9100
1895       VTAB 23 : HTAB 70 : INPUT "",AA
1900       IF AA=11 THEN 2020
1910       IF AA=99 THEN 2020
2000 ' --- SELETE PROPER PROGRAM ---
2010 CHAIN "PL-4.TXT"
2020 CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130    RETURN
9200       ' --- DRAW A TABLE ---
9210       VTAB 3 : HTAB 1 : PRINT STRING$ (78,"-")
9220       PRINT TAB(15) "ITEM" SPC(25) "NO." SPC(8) "$/NO." SPC(8) "TOTAL"
9230       FOR I=5 TO 21 STEP 2
9240         VTAB I : HTAB 1 : PRINT STRING$ (78,"-")
9250       NEXT I
9260       R60   A=A+2
9370 NEXT I
9380 RETURN
9400    ' --- PROCESSING FROM TABLE ---
9410    DIM FY(8)
9420    A=1
9430    FOR I=1 TO 8
9440      FY(I)=FZ(A)*FZ(A+1)
9450      A=A+2
9460    NEXT I
9470    RETURN
9500       ' --- O/P DATA TO TABLE ---
9510       J=5
9520       FOR I=6 TO 20 STEP 2
9530         VTAB I : HTAB 67 : PRINT FY(I-J)
9540         J=J+1
9550       NEXT I
9560       RETURN
```

```
6000 HOME : ' --- (4) WATCHING & LIGHTING ---
6010 PRINT TAB(20) "* SECTION (4) -- WATCHING & LIGHTING *" SPC(11) "DO P."
6015 PRINT TAB(20) STRING$ (38,"-")
6020 PRINT : PRINT : PRINT "(4.1) INITIAL POWER SUPPLY RATE" SPC(27) "$/ITEM :"
6030 PRINT : PRINT "(4.2) WATCHMEN"
6040 PRINT : PRINT TAB(10) "- NUMBER REQUIRE      :"
6050 PRINT TAB(10) "- MONTHLY SALARY      :"
6060 PRINT TAB(10) "- DURATION (IN MONTH) :"
6065 PRINT TAB(59) "$/ITEM :"
6070 PRINT : PRINT "(4.3) MONTHLY CONSUMPTION ($/MONTH) :"
6073 PRINT TAB(59) "$/ITEM :"
6075 PRINT : PRINT "(4.4) MISCELLANEOUS" SPC(39) "$/ITEM :"
6080  PRINT
6090 PRINT : PRINT "## SUMMARY ON WATCHING & LIGHTING IS $"
6100 GOSUB 9100
6110 GOSUB 9000
6115 IF DO$="*" THEN 6270
6120 ' --- INPUT DATA ---
6130 VTAB  5 : HTAB 68 : INPUT "",DA
6140 VTAB  9 : HTAB 34 : INPUT "",DB
6150 VTAB 10 : HTAB 34 : INPUT "",DC
6160 VTAB 11 : HTAB 34 : INPUT "",DD
6170 DE=DB*DC*DD
6180 VTAB 12 : HTAB 68 : PRINT DE
6190 VTAB 14 : HTAB 39 : INPUT "",DF
6200 DG=DF*DD
6210 VTAB 15 : HTAB 68 : PRINT DG
6220 VTAB 17 : HTAB 69 : INPUT "",DH
6230 DI=DA+DE+DG+DH
6240 VTAB 20 : HTAB 39 : PRINT DI
6250 VTAB 23 : HTAB 70 : INPUT "",AA
6260 IF AA=11 THEN 6000
6270 IF AA=99 THEN 7020
7000    ' --- SELETE PROPER PROGRAM ---
7010    CHAIN "PL-5.TXT"
7020    CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130  RETURN
```

```
6500    HOME : ' --- (5) INSURANCE ---
6510    PRINT TAB(25) "* SECTION (5) -- INSURANCE *" SPC(17) "00 P."
6515    PRINT TAB(25) STRING$ (28,"-")
6520    PRINT
6530    PRINT "(5.1) CONTRACT SUM ASSUMED TO BE" SPC(20) "$"
6535    PRINT : PRINT
6540    PRINT "(5.2) INSURANCE AGAINST ACCIDENT OR INJURY (IN %)" SPC(3) "-" SPC(10) "= $"
6550    PRINT : PRINT "(5.3) INSURANCE OF WORKS (IN %)" SPC(21) "-" SPC(10) "= $"
6560    PRINT : PRINT "(5.4) THIRD PARTY INSURANCE (IN %)" SPC(18) "-" SPC(10) "= $"
6570    PRINT : PRINT "(5.5) CARE OF WORKS (IN %)" SPC(26) "-" SPC(10) "= $"
6580    PRINT : PRINT "(5.6) MEETING CONTRACTOR'S LIABILITY IN RESPECT"
6590    PRINT "      OF DAMAGES TO PERSONS AND PROPERTY. (IN %)" SPC(4) "-" SPC(10) "= $"
6600    PRINT : PRINT
6610    PRINT "## SUMMARY ON SECTION (5) -- INSURANCE IS $"
6620    GOSUB 9100
6630    GOSUB 9000
6640    IF DO$="*" THEN 7000
6650    ' --- I/P DATA ---
6660    VTAB  4 : HTAB 55 : INPUT "",EA
6670    VTAB  7 : HTAB 55 : INPUT "",EB : EB=EB/100
6680    EC=EA*EB
6690    VTAB  7 : HTAB 67 : PRINT EC
6700    VTAB  9 : HTAB 55 : INPUT "",ED : ED=ED/100
6710    EE=EA*ED
6720    VTAB  9 : HTAB 67 : PRINT EE
6730    VTAB 11 : HTAB 55 : INPUT "",EF : EF=EF/100
6740    EG=EA*EF
6750    VTAB 11 : HTAB 67 : PRINT EG
6760    VTAB 13 : HTAB 55 : INPUT "",EH : EH=EH/100
6770    EI=EA*EH
6780    VTAB 13 : HTAB 67 : PRINT EI
6790    VTAB 16 : HTAB 55 : INPUT "",EJ : EJ=EJ/100
6800    EK=EA*EJ
6810    VTAB 16 : HTAB 67 : PRINT EK
6820    EL=EC+EE+EG+EI+EK
6830    VTAB 19 : HTAB 45 : PRINT EL
6835    ' --- ASK FOR CONT ---
6840    VTAB 23 : HTAB 70 : INPUT "",AA
6850    IF AA=11 THEN 6500
6860    IF AA=99 THEN 7020
7000    ' --- SELETE PROPER PROGRAM ---
7010    CHAIN "PL-6.TXT"
7020    CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 1 : PRINT STRING$ (79,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130    RETURN
```

```
7000       HOME : ' --- (6) SETTING OUT ---
7010       PRINT TAB(25) "* SECTION (6) -- SETTING OUT *" SPC(12) "DO. P.1"
7015       PRINT TAB(25) STRING$ (30,"-")
7020       PRINT : PRINT : PRINT "(6.1) DURATION (IN MONTH) :"
7030       PRINT : PRINT "(6.2) SURVEYING GANG"
7040       PRINT : PRINT TAB(25) "NUMBER" SPC(10) "MONTHLY SALARY" SPC(10) "TOTAL"
7050       PRINT TAB(25) "------" SPC(10) "--------------" SPC(10) "-----"
7060       PRINT : PRINT "SURVEYOR"
7070       PRINT : PRINT "ASS. SURVEYOR"
7080       PRINT : PRINT "CHAINMAN"
7090 PRINT : PRINT : PRINT "(6.3) MISCELLANEOUS : $"
7100       GOSUB 9100
7110       GOSUB 9000
7115       IF DO$="*" THEN 7300
7120 ' --- I/P DATA ---
7130 VTAB  5 : HTAB 29 : INPUT "",FA
7140 VTAB 12 : HTAB 25 : INPUT "",FB
7150 VTAB 12 : HTAB 41 : INPUT "",FC
7160 VTAB 14 : HTAB 25 : INPUT "",FD
7170 VTAB 14 : HTAB 41 : INPUT "",FE
7180 VTAB 16 : HTAB 25 : INPUT "",FF
7190 VTAB 16 : HTAB 41 : INPUT "",FG
7195 VTAB 19 : HTAB 25 : INPUT "",FK
7200 ' --- PROCESSING ---
7210 FH=FA*FB*FC
7220 FI=FA*FD*FE
7230 FJ=FA*FF*FG
7240 VTAB 12 : HTAB 64 : PRINT FH
7250 VTAB 14 : HTAB 64 : PRINT FI
7260 VTAB 16 : HTAB 64 : PRINT FJ
7270 VTAB 23 : HTAB 70 : INPUT "",AA
7280 IF AA=11 THEN 7000
7290 IF AA=99 THEN 8020
7300 HOME : ' --- EQUIPMENT TABLE ---
7310 M=1
7320 HOME : PRINT "(6.3) EQUIPMENT :" SPC(50) "DO P.";M+1
7330 GOSUB 9200
7340 IF AA=11 THEN 7410
7350 DIM ITEM$(8)
7360 FOR I=1 TO 8
7370   READ ITEM$(I)
7380 NEXT I
7390 DATA THEODOLITE, TRIPOD, PARALLEL PLATE MICROMETER, TARGET SET
7392 DATA CALCULATOR, STEEL BAND, 50 mm STILON TAPE, 30 mm STILON TAPE
7394 DATA POCKET LOCK, LEVELLING STAFF, PILLAR PLATE, TRANSCEIVER
7396 DATA RANGING ROD, SPIRIT BUBBLE LEVEL, CLINOMETER, THERMOMETER
7398 DATA ROLLER TYPE PLANIMETER, SINGLE FREQUENCY ECHO SOUNDER
7400 DATA C,C,C,C,C,C
7402 DATA D,D,D,D,D,D,D,D
7410 ' --- PRINT ITEM ---
7415 AA=0
7420 J=5
7425 FOR I=6 TO  20 STEP 2
7430   K=I-J
7435   VTAB I : HTAB 1 : PRINT ITEM$(K)
7440   J=J+1
7445 NEXT I
7450 GOSUB 9100
7455 GOSUB 9000
7460 LET N=M
7465 IF DO$="*" THEN 7570
7470 ' --- MANIPULATION ---
7475 GOSUB 9300
```

```
7490 GOSUB 9500
7500 VTAB 23 : HTAB 70 : INPUT "",AA
7510 IF AA=11 THEN 7580
7520 IF AA=99 THEN 7580
7530 Q=0 : FOR I=1 TO 8
7540         Q=Q+FY(I)
7550       NEXT I
7560 S(M)=Q
7570 M=M+1
7573 IF M=5 THEN 7650
7575 IF DO$="*" THEN 7590
7580 ERASE FY : ERASE FZ
7585 IF AA=11 THEN 7320
7590 ERASE ITEM$
7595 IF DO$="*" THEN 7320
7600 IF AA=99 THEN 8020
7605 IF M=N THEN 7610 ELSE 7320
7610 GOTO 7570
7650    HOME : ' --- SECTION 6 SUMMARY ---
7660    PRINT : PRINT TAB(20) "* SUMMARY ON SECTION (6) -- SETTING OUT *"
7670    PRINT TAB(20) STRING$ (41,"-")
7680    FL=FH+FI+FJ
7690    FM=S(1)+S(2)+S(3)+S(4)
7700    PRINT : PRINT : PRINT : PRINT
7710    PRINT TAB(10) "## RATE ON SURVEYING GANG          ------ $";FL
7720    PRINT : PRINT TAB(10) "## RATE ON EQUIPMENT              ------ $";FM
7730    PRINT : PRINT TAB(10) "## RATE ON MISCELLANEOUS          ------ $";FK
7735   PRINT : PRINT TAB(10) STRING$ (60,".")
7740    FO=FL+FM+FK
7750    PRINT : PRINT TAB(29) "## TOTAL RATE ------ $";FO
7760    GOSUB 9100
7770    VTAB 23 : HTAB 70 : INPUT "",AA
7780    IF AA=11 THEN 7790 ELSE 7800
7790    RESTORE : GOTO 7000
7800    IF AA=99 THEN 8020
8000       ' --- SELETE PROPRT PROGRAM ---
8010       CHAIN "PL-7.TXT"
8020       CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130   RETURN
9200       ' --- TABLE ---
9210       VTAB 3 : HTAB 1 : PRINT STRING$ (78,"-")
9220       PRINT TAB(15) "ITEM" SPC(25) "NO." SPC(8) "$/NO." SPC(8) "TOTAL"
9230       FOR I=5 TO 21 STEP 2
9240         VTAB I : HTAB 1 : PRINT STRING$ (78,"-")
9250       NEXT I
9260       RETURN
9300 ' --- I/P DATA FROM TABLE ---
9310 DIM     DIM FY(8)
9420    A=1
9430    FOR I=1 TO 8
9440      FY(I)=FZ(A)*FZ(A+1)
9450      A=A+2
9460    NEXT I
9470    RETURN
9500       ' --- O/P DATA TO TABLE ---
9510       J=5
9520       FOR I=6 TO 20 STEP 2
9530         VTAB I : HTAB 67 : PRINT FY(I-J)
9540         J=J+1
9550       NEXT I
9560       RETURN
```

```
8000 HOME : ' --- (7) PROVISION TRANSP. TO ENGINEER ---
8010 PRINT TAB(15) "* SECTION (7) -- PROVISION TRANSP. TO ENGINEER *" SPC(7) "DO P."
8015 PRINT TAB(15) STRING$ (48,"-")
8020 PRINT : PRINT "(7.1) DURATION (IN MONTH) :"
8030 PRINT : PRINT "(7.2) PROVISION OF VEHICLE"
8040 PRINT TAB(13) "- NUMBER REQUIRE :"
8050 PRINT TAB(14) "- $/VEHICLE     :"
8060 PRINT TAB(60) "$/ITEM :"
8070 PRINT "(7.3) OPERATING/MAINTENANCE"
8080 PRINT TAB(13) "- NO. OF DRIVER          :"
8090 PRINT TAB(14) "- MONTHLY SALARY         :"
8100 PRINT TAB(15) "- CONSUMABLES ($/MONTH) :" SPC(20) "$/ITEM :"
8110 PRINT
8120 PRINT "(7.4) ASSISTANCE" SPC(43) "$/ITEM :"
8130 PRINT : PRINT "(7.5) CHAINMAN" SPC(45) "$/ITEM :"
8140 PRINT : PRINT "(7.6) MARINE TRANSP." SPC(39) "$/ITEM :"
8150 PRINT : PRINT "## SUMMARY ON SECTION (7) -- TRANSP. TO ENGINNER IS $"
8160 GOSUB 9100
8170 GOSUB 9000
8180 IF DO$="*" THEN 8510
8200 VTAB 4 : HTAB 29 : INPUT "",GA
8205 VTAB 7 : HTAB 32 : INPUT "",GB
8210 VTAB 8 : HTAB 32 : INPUT "",GC
8215 GD=GB*GC
8220 VTAB 9 : HTAB 68 : PRINT GD
8225 VTAB 11 : HTAB 41 : INPUT "",GE
8230 VTAB 12 : HTAB 41 : INPUT "",GF
8235 VTAB 13 : HTAB 41 : INPUT "",GG
8240 GH=(GE*GF*GA)+(GG*GA)
8245 VTAB 13 : HTAB 68 : PRINT GH
8250 VTAB 15 : HTAB 69 : INPUT "",GI
8255 VTAB 17 : HTAB 69 : INPUT "",GJ
8260 VTAB 19 : HTAB 69 : INPUT "",GK
8265 GL=GD+GH+GI+GJ+GK
8270 VTAB 21 : HTAB 54 : PRINT GL
8275 ' --- ASK FOR CONT ---
8280 VTAB 23 : HTAB 70 : INPUT "",AA
8285 IF AA=11 THEN 8000
8290 IF AA=99 THEN 8520
8500 ' --- SELETE PROPER PROGRAM ---
8510 CHAIN "PL-8.TXT"
8520 CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130   RETURN
```

```
8542    VTAB 19 : HTAB 58 : PRINT HQ
8544    VTAB 20 : HTAB 58 : PRINT HP
8546    VTAB 21 : HTAB 58 : PRINT HQ
8548    ' --- ASK FOR CONT ---
8549    VTAB 23 : HTAB 70 : INPUT "",AA
8550    IF AA=11 THEN 8300
8560    IF AA=99 THEN 8920
8900 ' --- SELETE PROPER PROGRAM ---
8910 CHAIN "PL-9.TXT"
8920 CHAIN "PL-0.TXT"
9000 ' --- ASK FOR DO ---
9010 VTAB 1 : HTAB 75 : INPUT "",DO$
9020 RETURN
9100    ' --- ASK FOR CONT ---
9110    VTAB 22 : HTAB 4 : PRINT STRING$ (71,"-")
9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
9130  RETURN
```

```
8300    HOME : ' --- (8) TRAFFIC ---
8310    PRINT TAB(25) "* SECTION (8) -- TRAFFIC *" SPC(18) "DO P."
8315    PRINT TAB(25) STRING$ (26,"-")
8320    PRINT : PRINT "(8.1) TRAFFIC SAFETY AND CONTROL" SPC(25) "$/ITEM :"
8330    PRINT : PRINT "(8.2) TRAFFIC SIGNBOARD" SPC(34) "$/ITEM :"
8340    PRINT : PRINT "(8.3) LOOKOUT MEN"
8345    PRINT TAB(10) "- DURATION (IN MONTH) :"
8350    PRINT TAB(10) "- NUMBER REQUIRE      :"
8360    PRINT TAB(10) "- MONTHLY SALARY      :" SPC(25) "$/ITEM :"
8370    PRINT : PRINT "(8.4) TRAFFIC DIVERSION"
8380    PRINT TAB(10) "- FREQUENCY (H/M/L)   :" SPC(10) "- SITE LOCATION (U/R) :"
8382    PRINT
8384    PRINT TAB(4) STRING$ (71,"-")
8385    PRINT TAB(4) "I" SPC(9) "PASS 3 RC'D" SPC(12) "SUGGEST RATE" SPC(12) "SUMMARY" SPC(6) "I"
8386    PRINT TAB(4) STRING$ (71,"-")
8387    PRINT TAB(4) "I (1)" SPC(65) "I"
8388    PRINT TAB(4) "I (2)" SPC(65) "I"
8389    PRINT TAB(4) "I (3)" SPC(65) "I"
8392    GOSUB 9100
8395    GOSUB 9000
8396    IF DO$="*" THEN 8910
8400    ' --- I/P DATA ---
8405    VTAB 4 : HTAB 67 : INPUT "",HA
8410    VTAB 6 : HTAB 67 : INPUT "",HB
8415    VTAB 9 : HTAB 34 : INPUT "",HC
8420    VTAB 10 : HTAB 34 : INPUT "",HD
8423    VTAB 11 : HTAB 34 : INPUT "",HE
8425    HF=HC*HD*HE
8430    VTAB 11 : HTAB 67 : PRINT HF
8440    VTAB 14 : HTAB 34 : INPUT "",HG$
8445    VTAB 14 : HTAB 67 : INPUT "",HH$
8450    VTAB 19 : HTAB 12 : INPUT "",HI
8455    VTAB 20 : HTAB 12 : INPUT "",HJ
8460    VTAB 21 : HTAB 12 : INPUT "",HK
8500    ' --- PROCESSING ---
8502    IF HG$="H" THEN 8504 ELSE 8506
8504    LET HG=3 : GOTO 8514
8506    IF HG$="M" THEN 8508 ELSE 8510
8508    LET HG=2 : GOTO 8514
8510    IF HG$="L" THEN 8512 ELSE 8514
8512    LET HG=1
8514    IF HH$="U" THEN 8516 ELSE 8518
8516    LET HH=2 : GOTO 8522
8518    IF HH$="R" THEN 8520 ELSE 8522
8520    LET HH=1
8522    HL=HI*HG*HH
8524    HM=HJ*HG*HH
8526    HN=HK*HG*HH
8528    HO=HA+HB+HF+HL
8530    HP=HA+HB+HF+HM
8532    HQ=HA+HB+HF+HN
8534    ' --- O/P DATA ---
8536    VTAB 19 : HTAB 36 : PRINT HL
8538    VTAB 20 : HTAB 36 : PRINT HM
8540    VTAB 21 : HTAB 36 : PRINT HN
```

```
 8800        HOME : ' --- (9) MISCELLANEOUS ---
 8805        PRINT TAB(20) "* SECTION (9) -- MISCELLANEOUS *" SPC(17) "DO P."
 8806        PRINT TAB(20) STRING$ (32,"-")
 8810        PRINT : PRINT : PRINT "(9.1) SITE CLEARANCE"
 8815        PRINT : PRINT "(9.2) PROGRESS PHOTOGRAPH"
 8820        PRINT : PRINT "(9.3) OFFICE ATTENTENT"
 8825        PRINT : PRINT "(9.4) FIELD  ATTENTENT"
 8830        PRINT : PRINT "(9.5) PREVENTION OF MOSQUITO BLEEDING"
 8835        PRINT : PRINT "(9.6) OTHERS"
 8837         PRINT : PRINT : PRINT : PRINT "## SUMMARY ON SECTION (9) -- MISCELLANEOUS IS $"
 8840        FOR I=5 TO 15 STEP 2
 8845          VTAB I : HTAB 52 : PRINT "$/ITEM :"
 8850        NEXT I
 8855        GOSUB 9100
 8860        GOSUB 9000
 8865         IF DO$="*" THEN 100
 8870         ' --- I/P DATA ---
 8875         VTAB  5 : HTAB 61 : INPUT "",IA
 8880         VTAB  7 : HTAB 61 : INPUT "",IB
 8885         VTAB  9 : HTAB 61 : INPUT "",IC
 8890         VTAB 11 : HTAB 61 : INPUT "",ID
 8895         VTAB 13 : HTAB 61 : INPUT "",IE
 8900         VTAB 15 : HTAB 61 : INPUT "",IG
 8905         IH=IA+IB+IC+ID+IE+IG
 8910         VTAB 19 : HTAB 48 : PRINT IH
 8915         ' -- ASK FOR CONT ---
 8920         VTAB 23 : HTAB 70 : INPUT "",AA
 8925         IF AA=11 THEN 8800
 8930         CHAIN "PL-0.TXT"
 9000 ' --- ASK FOR DO ---
 9010 VTAB 1 : HTAB 75 : INPUT "",DO$
 9020 RETURN
 9100    ' --- ASK FOR CONT ---
 9110    VTAB 22 : HTAB 1 : PRINT STRING$ (78,"-")
 9120    PRINT "## 11-- RENEW/ 99-- EXIT/ RETURN-- CONTINUE" SPC(17) "CHOICE :"
 9130   RETURN
```

Appendix V

Structure Programme

(A) H O W T O U S E

Procedure :

(1) Switch on the computer.
(2) Switch on the monitor.
(3) Insert the proper disk into drive while the IN-USE lamp is on.
(4) Close the drive door.
(5) Use 'DIR' to check whether it is the proper disk.
(6) Type in 'MBASIC'.
(7) Wait for a while until 'OK' is displayed.
(8) Type in 'LOAD STRUCT.TXT' to load the STRUCTURE PROGRAM from disk to CPU.
(9) Wait for a while until 'OK' is displayed.
(10) Type in 'RUN', then 'STRUCT.TXT' is started.
(11) Select your choice and follow the concise instructions displayed on the screen.
(12) Usually, you may continue the program by pressing 'RETURN'.
(13) You may EXIT from program by pressing '9' at each end page choice.

FOR SPECIAL PURPOSE PROGRAM SELECTION

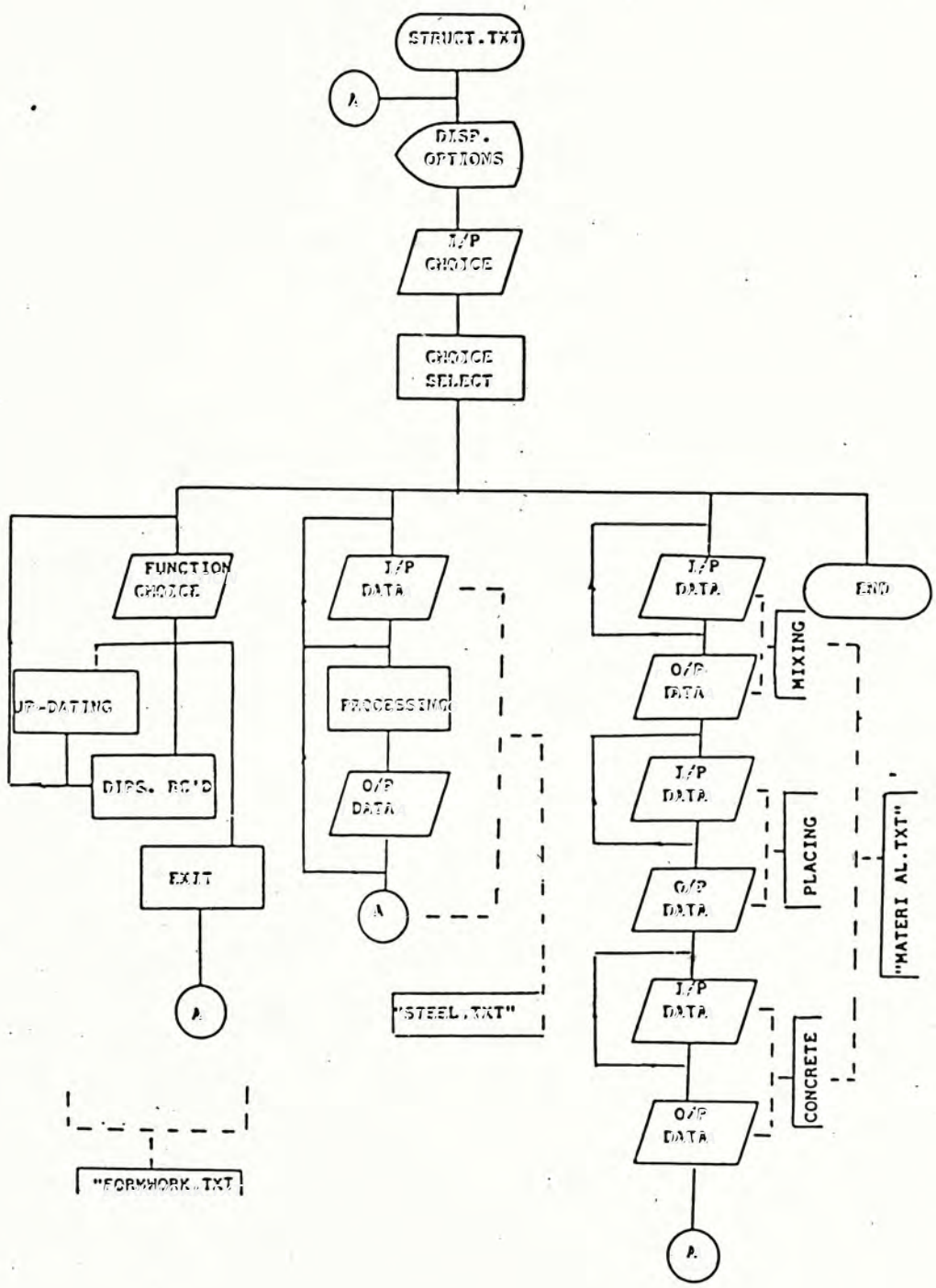
** Three programmes are available :

'FORMWORK.TXT'
'STEEL.TXT'
'MATERIAL.TXT'

Procedure :

(1) Switch on the computer.
(2) Switch on the monitor.
(3) Insert the proper disk into drive while the IN-USE LAMP is on.
(4) Close yhr drive door.
(5) Use 'DIR' to check whether it is the proper disk.
(6) Type in 'MBASIC'.
(7) Wait for a while until 'OK' is displayed.
(8) Type in 'RUN program-name' to load the specified program from disk to CPU..
(9) Wait for a while until 'OK' is displayed.
(10) Follow the concise instructions displayed on the screen.
(11) Usually, you may continue the program by pressing 'RETURN'.
(12) You may EXIT from program by pressing '9' at the end page choice.

(B) Programme Flow Charts



Appendix V – C

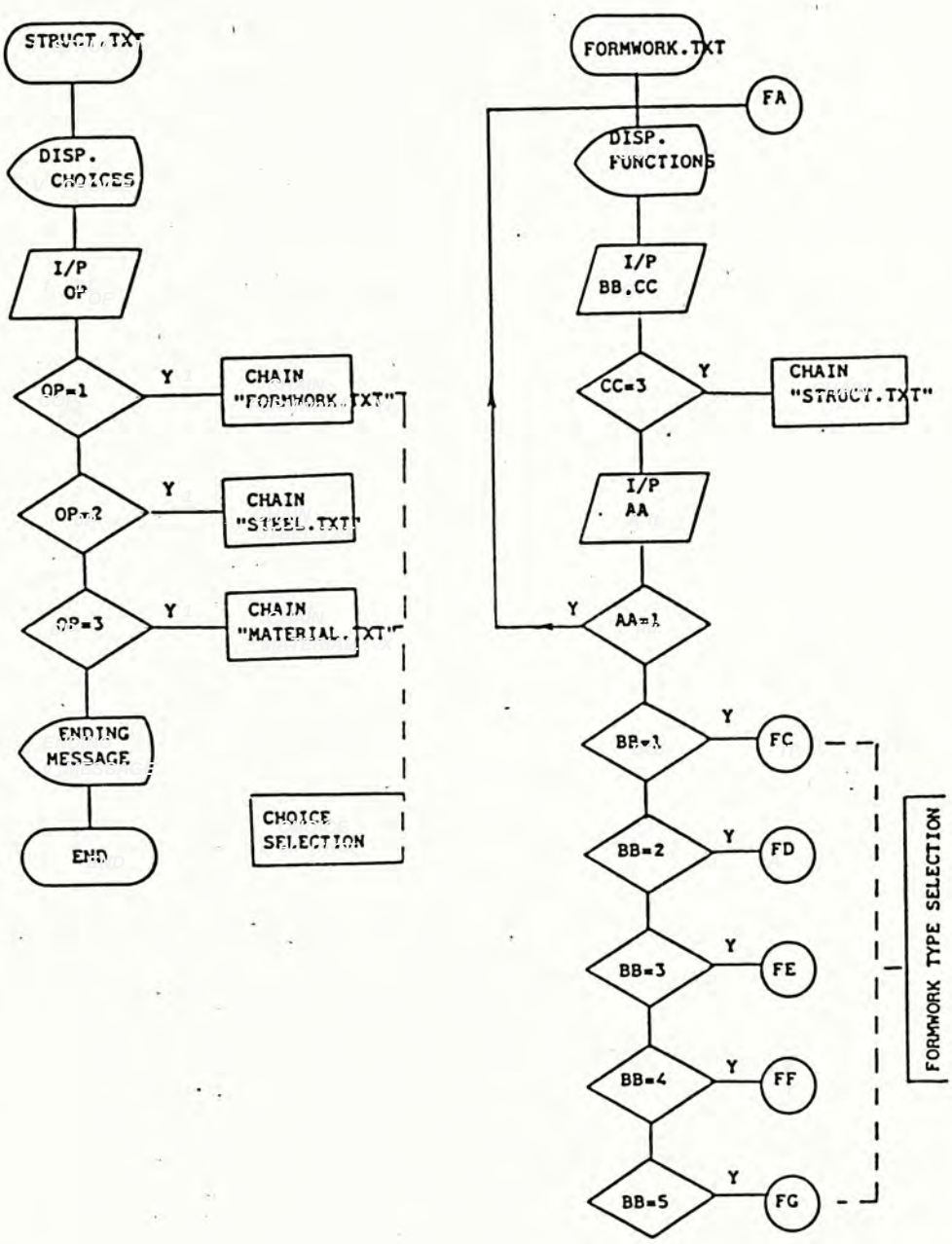
(C) Program

```
500 HOME : ' --- CHOICES DISPALY ---
510 PRINT TAB(30) "* STRUCTURE PROGRAM *" : PRINT TAB(30) "----------------------"
520 PRINT : PRINT : PRINT TAB(31) "OPTIONS AVAILABLE :" : PRINT TAB(31) "----------
530 PRINT : PRINT TAB(33) "(1) FORM WORK"
540 PRINT : PRINT TAB(33) "(2) STEEL - BENDING & FIXING"
550 PRINT : PRINT TAB(33) "(3) CONCRETE"
560 PRINT : PRINT TAB(33) "(4) EXIT"
570 PRINT : PRINT : PRINT : PRINT STRING$ (78,"-")
580 INPUT "## CHOICE : ",OP
600     ' --- SELECTION ---
610     IF OP=1 THEN 620 ELSE 630
620     CHAIN "FORMWORK.TXT"
630     IF OP=2 THEN 640 ELSE 650
640     CHAIN "STEEL.TXT"
650     IF OP=3 THEN 660 ELSE 9000
660     CHAIN "MATERIAL.TXT"
9000          HOME : ' --- END OF STRUCTURE PROGRAM ---
9010          VTAB  7 : HTAB 20 : PRINT "------------------------------"
9020          PRINT TAB(20) "I" SPC(28) "I"
9030          PRINT TAB(20) "I  END OF STRUCTURE PROGRAM  I"
9040          PRINT TAB(20) "I" SPC(28) "I"
9050          PRINT TAB(20) "------------------------------"
9060          END
```

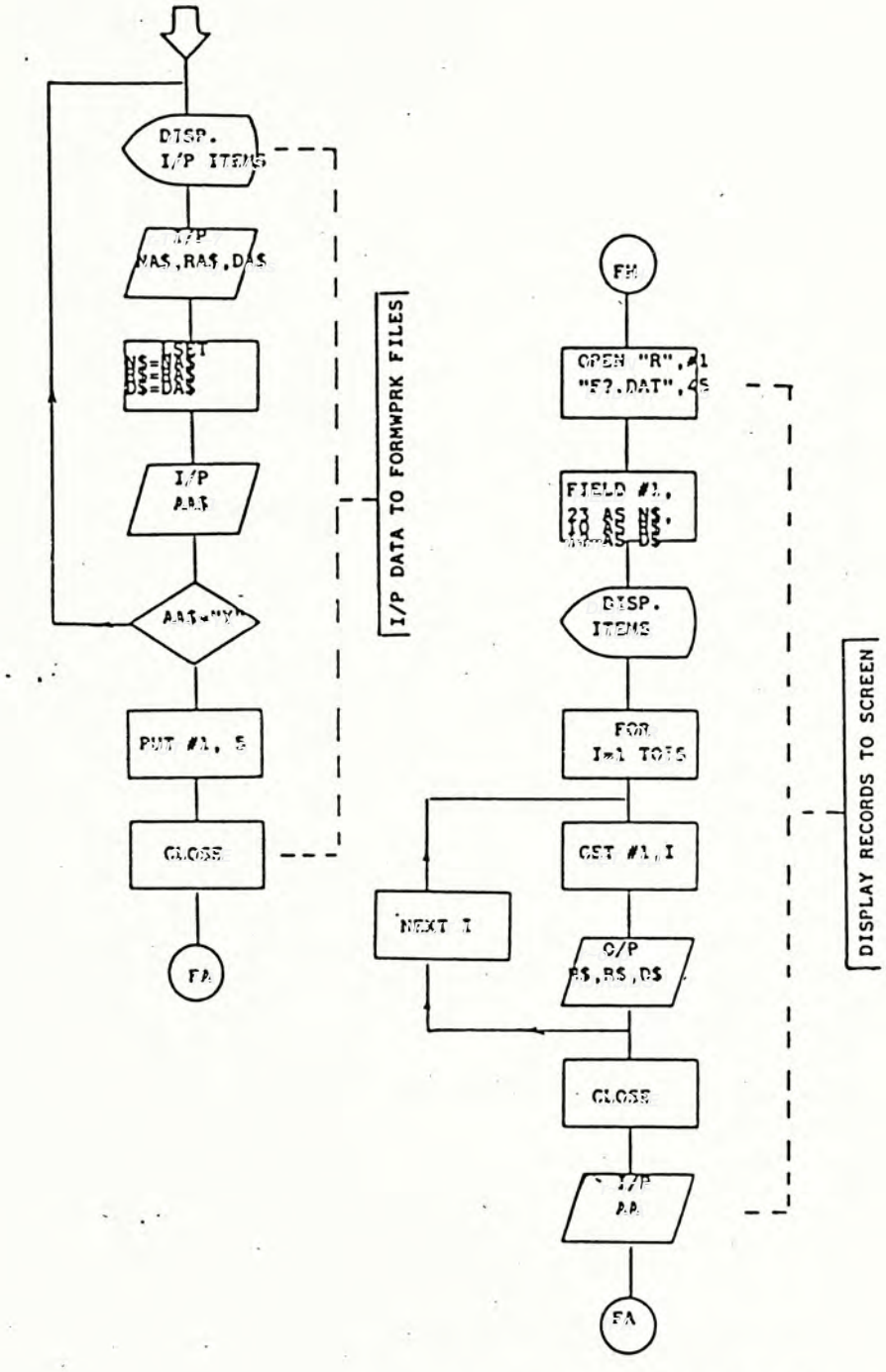
Appendix VI

Formwork

(A) Flow Chart



Appendix VI - A2



* WHERE "?" STANDS FOR 1 TO 5

(B) Program

```
500 HOME : ' --- CHOICES DISPALY ---
510 PRINT TAB(30) "* STRUCTURE PROGRAM *" : PRINT TAB(30) "----------------------"
520 PRINT : PRINT : PRINT TAB(31) "OPTIONS AVAILABLE :" : PRINT TAB(31) "-----------------"
530 PRINT : PRINT TAB(33) "(1) FORM WORK"
540 PRINT : PRINT TAB(33) "(2) STEEL - BENDING & FIXING"
550 PRINT : PRINT TAB(33) "(3) CONCRETE"
560 PRINT : PRINT TAB(33) "(4) EXIT"
570 PRINT : PRINT : PRINT : PRINT STRING$ (78,"-")
580 INPUT "## CHOICE : ",OP
600    ' --- SELECTION ---
610    IF OP=1 THEN 620 ELSE 630
620    CHAIN "FORMWORK.TXT"
630    IF OP=2 THEN 640 ELSE 650
640    CHAIN "STEEL.TXT"
650    IF OP=3 THEN 660 ELSE 9000
660    CHAIN "MATERIAL.TXT"
9000         HOME : ' --- END OF STRUCTURE PROGRAM ---
9010         VTAB  7 : HTAB 20 : PRINT "-----------------------------"
9020         PRINT TAB(20) "I" SPC(28) "I"
9030         PRINT TAB(20) "I  END OF STRUCTURE PROGRAM  I"
9040         PRINT TAB(20) "I" SPC(28) "I"
9050         PRINT TAB(20) "-----------------------------"
9060         END
```

```
1000    ' --- FORM WORK PROGRAM ---
1010    HOME : ' --- CHOICE & FUNCTION SELETION ---
1020    PRINT TAB(30) "* FORMWORK PROGRAM *" : PRINT TAB(30) "----------------------"
1030    PRINT : PRINT "## CHOICE OF FORMWORK :"
1040    PRINT : PRINT TAB(35) "(1) F1" : PRINT TAB(35) "(2) F2" : PRINT TAB(35) "(3) F3"
1050    PRINT TAB(35) "(4) F4" : PRINT TAB(35) "(5) F5"
1060    PRINT : PRINT TAB(60) "## CHOICE : "
1070    PRINT "## FUNCTION AVAILABLE :"
1080    PRINT : PRINT TAB(35) "(1) UP-DATE" : PRINT TAB(35) "(2) DISPLAY RECORDS" : PRINT TAB(35) "(3) EXIT"
1090    PRINT TAB(60) "## CHOICE :"
1100    PRINT : PRINT STRING$ (78,"-")
1110    PRINT "## PRESS '1' FOR RE-ENTER"
1120    PRINT "## PRESS RETURN FOR CONTINUE" SPC(31) "## CHOICE :"
1125    PRINT "## PRESS '9' FOR EXIT"
1130       ' --- ASK FOR CHOICE ---
1140       VTAB 12 : HTAB 72 : INPUT "", BB
1150       VTAB 18 : HTAB 72 : INPUT "",CC
1155       IF CC=3 THEN 5000
1160       VTAB 22 : HTAB 72 : INPUT "",AA
1170       IF AA=1 THEN 1010
1172       IF AA=9 THEN 1175 ELSE 1180
1175       CHAIN "STRUCT.TXT"
1180          ' --- CHOICE OF FORM WORK ---
1182          IF BB=1 THEN 1220 ELSE 1184
1184          IF BB=2 THEN 1700 ELSE 1186
1186          IF BB=3 THEN 2200 ELSE 1188
1188          IF BB=4 THEN 2700 ELSE 1190
1190          IF BB=5 THEN 3200 ELSE 1140
```

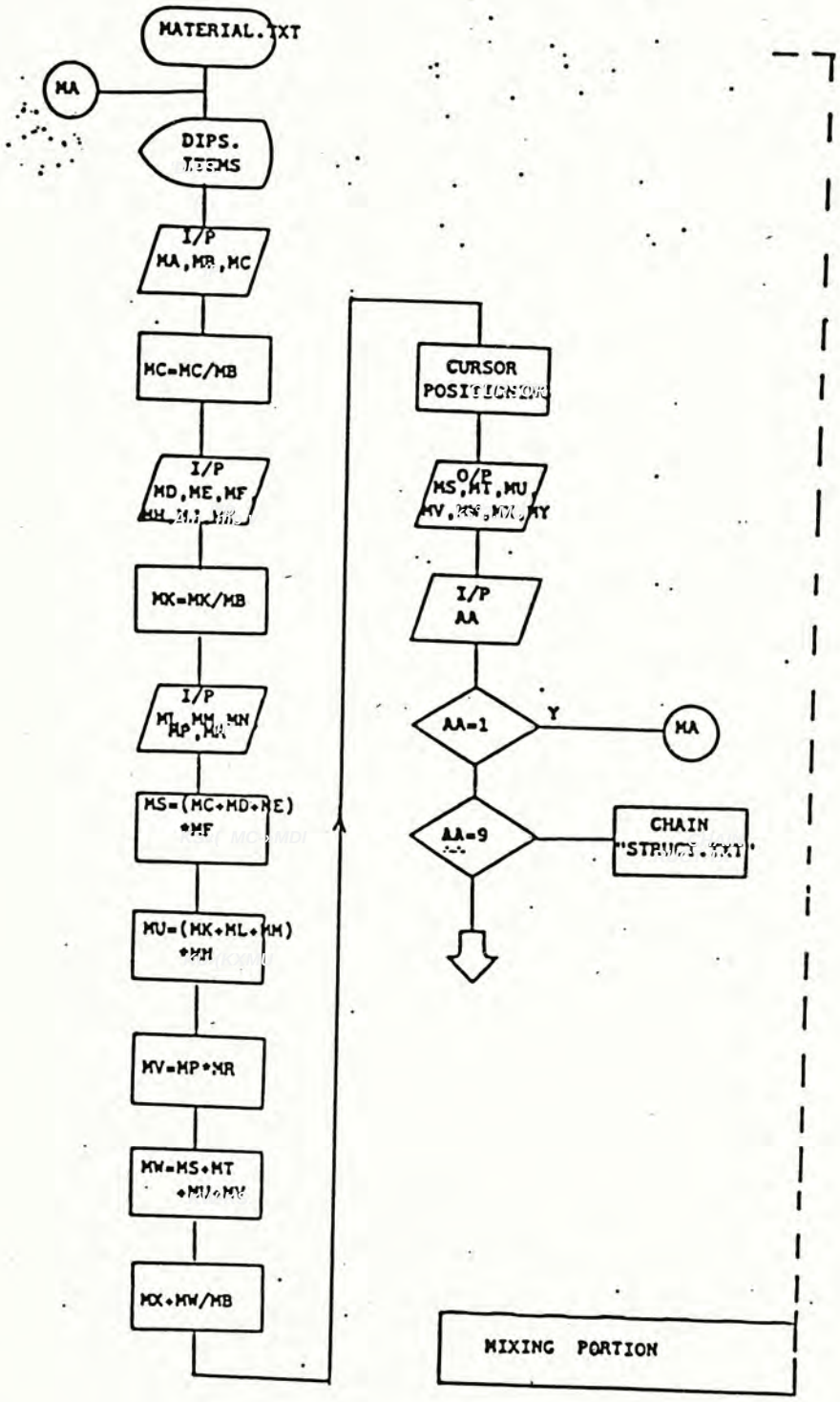
Appendix VI - B2

```
1200 ' --- F1 ---
1210 IF BB=1 THEN 1220 ELSE 1700
1220 IF CC=1 THEN 1230 ELSE 1510
1230 OPEN "R", #1, "F1.DAT",45
1240 FIELD #1, 23 AS N$, 10 AS R$, 12 AS D$
1250 FOR I=1 TO 5
1260   GET #1, I
1270   LET FA$(I,1)=N$
1280   LET FA$(I,2)=R$
1290   LET FA$(I,3)=D$
1300 NEXT I
1310 FOR I=1 TO 4
1320   FOR J=1 TO 3
1330     LET FA$(I,J)=FA$(I+1,J)
1340   NEXT J
1350 NEXT I
1360 FOR I=1 TO 4
1370   LSET N$=FA$(I,1)
1380   LSET R$=FA$(I,2)
1390   LSET D$=FA$(I,3)
1400   PUT #1, I
1410 NEXT I
1420 HOME : : PRINT : PRINT : PRINT TAB(25) "* ENTER INFORMATION FOR F1 *" : PRINT TAB(25) "----------
1430 PRINT : PRINT : PRINT "## SUB-CONTRACTOR :" SPC(24) ":"
1433 PRINT : PRINT "## RATE           :" SPC(11) ":"
1435 PRINT : PRINT "## DATE           :" SPC(13) ":"
1440 PRINT : PRINT : PRINT "## ANY CORRECTION (Y/N) :"
1450    ' --- CORSOR POSITIONING ---
1460    VTAB  7 : HTAB 21 : INPUT "",NA$ : LSET N$=NA$
1470    VTAB  9 : HTAB 21 : INPUT "",RA$ : LSET R$=RA$
1480    VTAB 11 : HTAB 21 : INPUT "",DA$ : LSET D$=DA$
1490    VTAB 14 : HTAB 27 : INPUT "",AA$
1500    IF AA$="Y" THEN 1420
1502    PUT #1, 5
1504    CLOSE
1505    GOTO 1010
1510 HOME : ' --- F1 RETRIVEAL ---
1520 OPEN "R", #1, "F1.DAT", 45
1530 FIELD #1, 23 AS N$, 10 AS R$, 12 AS D$
1540 VTAB 3 : HTAB 30 : PRINT "* RECORD OF F1 *" : PRINT TAB(30) "----------------"
1550 PRINT : PRINT TAB(10) "SUB-CONTRACTOR" SPC(14) "RATE" SPC(20) "DATE"
1560 PRINT TAB(10) "--------------" SPC(12) "--------" SPC(16) "--------"
1570 FOR I=1 TO 5
1580   GET #1,I
1590   PRINT : VTAB 8+I : HTAB 10 : PRINT N$
1600           VTAB 8+I : HTAB 36 : PRINT "$ ";R$
1610           VTAB 8+I : HTAB 60 : PRINT D$
1620 NEXT I
1625 CLOSE
1630 VTAB 20 : HTAB 1 : PRINT STRING$ (78,"-")
1640 INPUT "## PRESS RETURN FOR CONTINUE ",AA
1650 GOTO 1010
```

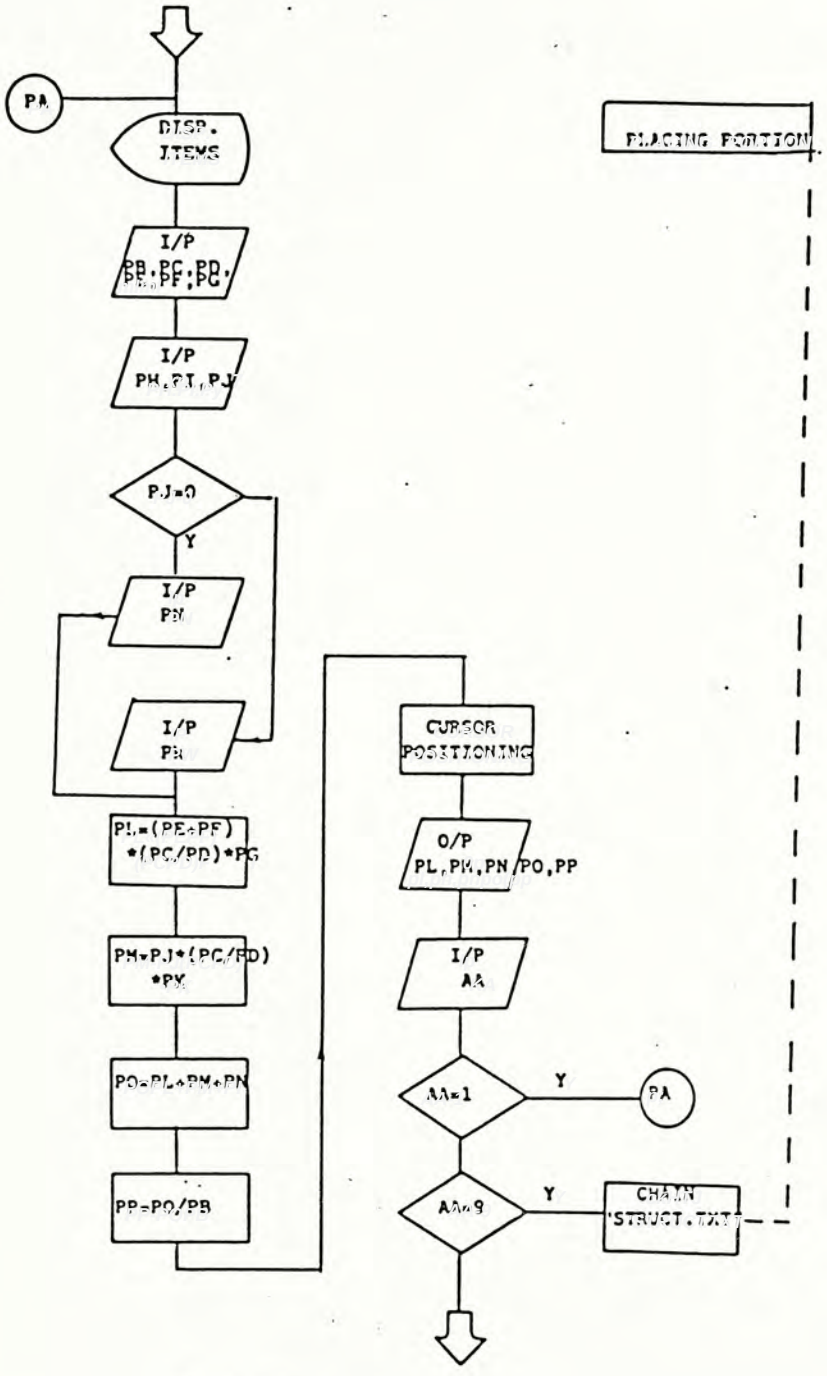
Appendix VII

Concrete

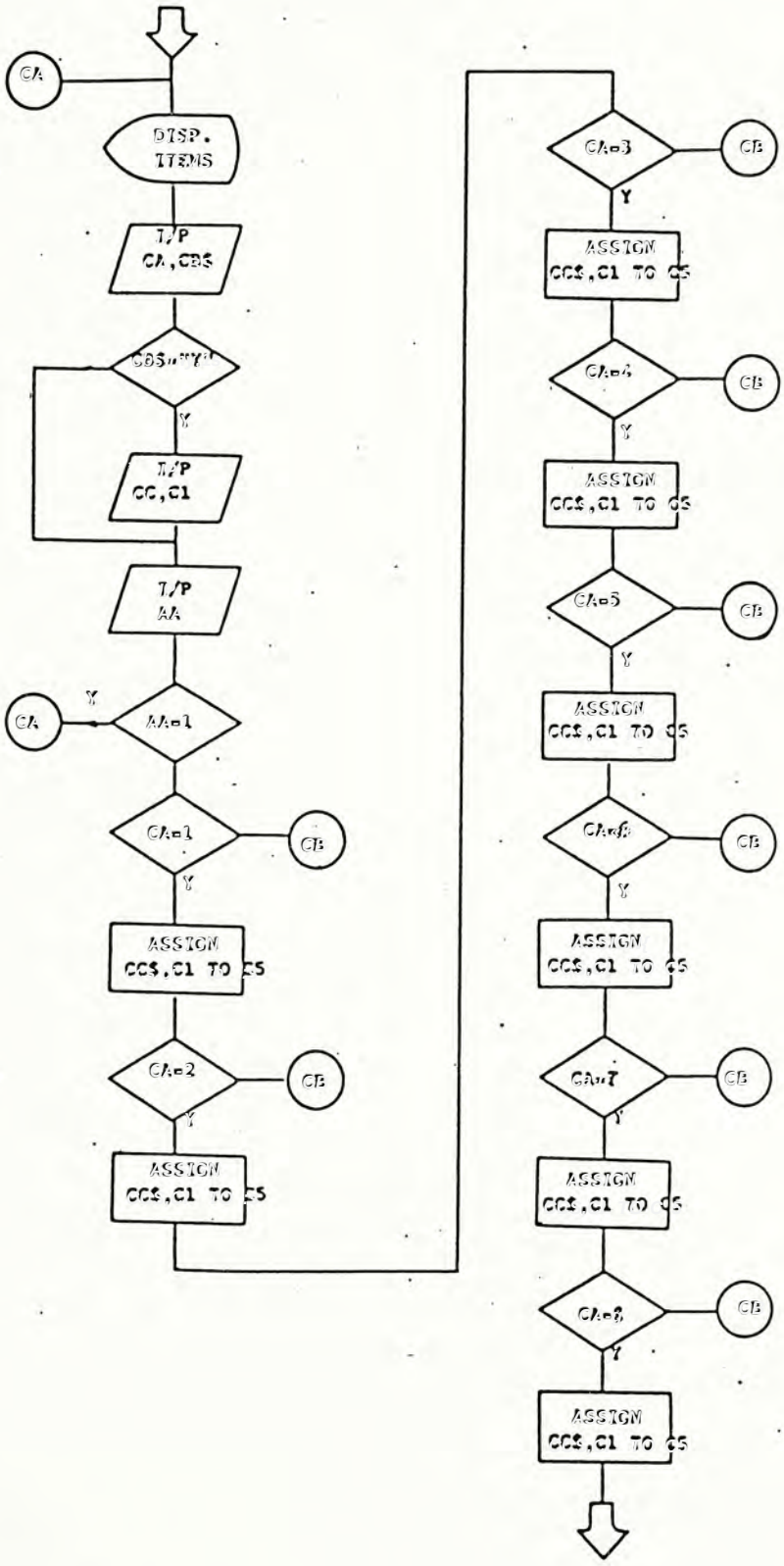
(A) Flow Chart

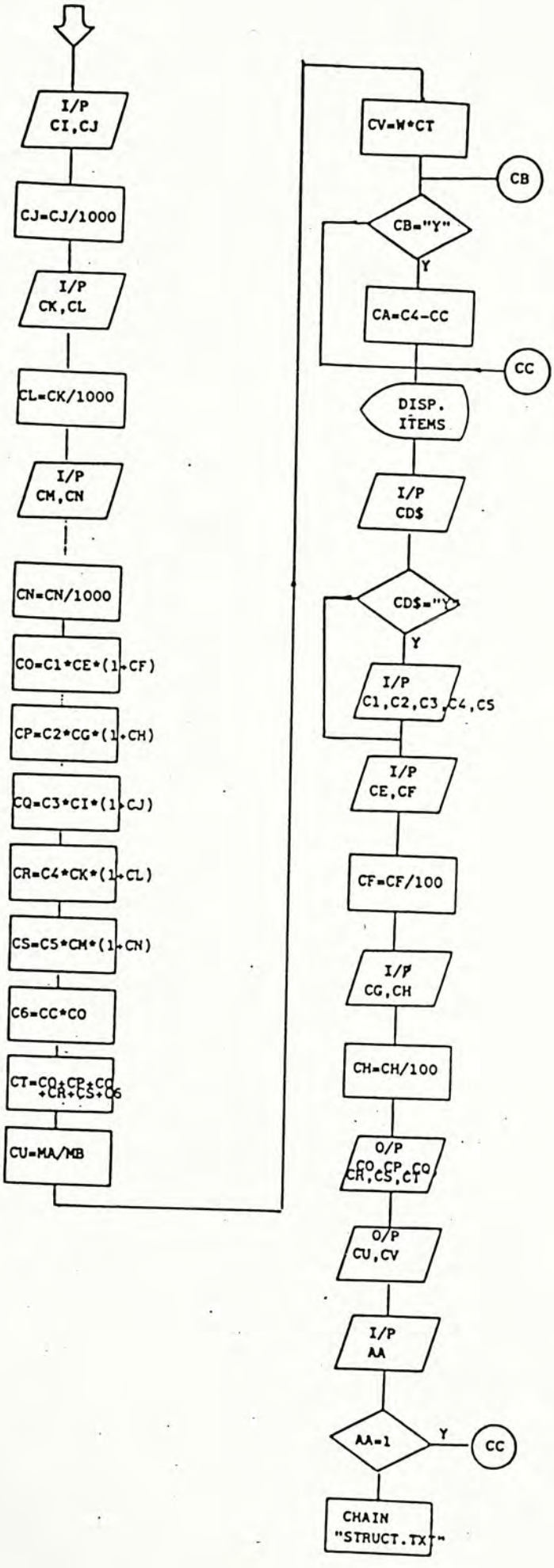


Appendix VII - A2



Appendix VII – A3




I/P CI,CJ
CJ=CJ/1000
I/P CK,CL
CL=CK/1000
I/P CM,CN
CN=CN/1000
CO=C1*CE*(1+CF)
CP=C2*CG*(1+CH)
CQ=C3*CI*(1+CJ)
CR=C4*CK*(1+CL)
CS=C5*CM*(1+CN)
C6=CC*CO
CT=CO+CP+CQ +CR+CS+C6
CU=MA/MB
CV=W*CT
CB
CB="Y"
Y
CA=C4-CC
CC
DISP. ITEMS
I/P CD$
CD$="Y"
Y
I/P C1,C2,C3,C4,C5
I/P CE,CF
CF=CF/100
I/P CG,CH
CH=CH/100
O/P CO,CP,CQ CR,CS,CT
O/P CU,CV
I/P AA
AA=1
Y
CC
CHAIN "STRUCT.TXT"

(B) Program

```
100 HOME : ' --- CONC. MIXING ---
110 ' --- SCREEN FORMATING ---
120 PRINT TAB(30) "* CONC. MIXING *" : PRINT TAB(30) "----------------"
130 PRINT : PRINT "## TOTAL QUANTITY (IN CU. METER) --"
140 PRINT "## CONTRACT DURATION (IN MONTH ) --"
150 PRINT : PRINT "RESOURCES      SET-UP        HIRE     CONSUMABLES        NUMBER          COST"
160 PRINT "EMPLOYED      ($/MONTH)    ($/MONTH)  ($/MONTH)       (NO./MONTH)   ($/MONTH)
170 PRINT "--------      ---------    --------- ------------     -----------   ---------"
180 PRINT "BATCHING      $            $          $               -             $"
190 PRINT "PLANT"
200 PRINT : PRINT "LABOUR/                      $                                -             $"
210 PRINT "SUPERVISOR"
220 PRINT : PRINT "TRANSIT MIXER $              $          $                     -             $"
230 PRINT : PRINT "DRIVER                       $                                -             $"
240 PRINT STRING$ (78,".")
250 PRINT : PRINT "## TOTAL MIXING COST                 -- $"
260 PRINT "## AVERAGE MONTHLY MIXING COST  -- $"
270 PRINT "## COST OF MIXING PER CU. METER -- $"
280    ' --- CURSOR POSITIONING & INPUT DATA ---
290    VTAB  4 : HTAB 37 : INPUT "",MA
300    VTAB  5 : HTAB 37 : INPUT "",MB
310    VTAB 10 : HTAB 17 : INPUT "",MC
320    VTAB 10 : HTAB 30 : INPUT "",MD
330    VTAB 10 : HTAB 41 : INPUT "",ME
340    VTAB 10 : HTAB 58 : INPUT "",MF
360    VTAB 13 : HTAB 30 : INPUT "",MH
380    VTAB 13 : HTAB 58 : INPUT "",MJ
390    VTAB 16 : HTAB 17 : INPUT "",MK
400    VTAB 16 : HTAB 30 : INPUT "",ML
410    VTAB 16 : HTAB 41 : INPUT "",MM
420    VTAB 16 : HTAB 58 : INPUT "",MN
440    VTAB 18 : HTAB 30 : INPUT "",MP
460    VTAB 18 : HTAB 58 : INPUT "",MR
470       ' --- PROCESSING ---
480       MS=(MC+MD+ME)*MF
490       MT=MH*MJ
500       MU=(MK+ML+MM)*MN
510       MV=MP*MR
520       MW=MS+MT+MU+MV
530       MX=MW/MB
540       MY=MX/(MA/MB)
550 ' --- CURSOR POSITIONING & OUTPUT DATA ---
560 VTAB 10 : HTAB 73 : PRINT "";MS
570 VTAB 13 : HTAB 73 : PRINT "";MT
580 VTAB 16 : HTAB 73 : PRINT "";MU
590 VTAB 18 : HTAB 73 : PRINT "";MV
600 VTAB 21 : HTAB 38 : PRINT "";MW
610 VTAB 22 : HTAB 38 : PRINT "";MX
620 VTAB 23 : HTAB 38 : PRINT "";MY
630 VTAB 23 : HTAB 70 : INPUT "",AA
640 IF AA=1 THEN 100
650 IF AA=9 THEN 660 ELSE 1000
660 CHAIN "STRUCT.TXT"
```

```
1000          HOME : ' --- CONC. PLACING ---
1010          PRINT TAB(30) "* CONC. PLACING *" : PRINT TAB(30) "-----------------"
1015          PRINT
1020          PRINT "## TOTAL QUANTITY    (IN CU. METER) --";MA
1030          PRINT "## AVERAGE POUR SIZE (IN CU. METER) --"
1040          PRINT "## POURING TIME  PER DAY  (IN HOUR) --"
1050          PRINT "## WORKING HOURS PER DAY  (IN HOUR) --"
1055          PRINT
1060          PRINT "RESOURCES       HIRE          CONSUMABLES        NUMBER          COST"
1070          PRINT "EMPLOYED     ($ / DAY)        ($ / DAY)        (NO./DAY)      ($ / DAY)
1080          PRINT "--------     ---------        ----------       ---------      ---------"
1090          PRINT "PLANT        $                $                -              $"
1095          PRINT
1100          PRINT "LABOUR       $                                 -              $"
1105          PRINT
1110          PRINT "EQUIPMENT    $                                 -              $"
1120          PRINT STRING$ (78,".")
1125          PRINT
1130          PRINT TAB(33) "## TOTAL COST / ONE POUR   -- $"
1140          PRINT TAB(33) "## PLACING COST /CU. METER -- $"
1150          PRINT "## PRESS '1' FOR RE-ENTER"
1160          PRINT "## PRESS '9' FOR EXIT"
1170          PRINT "## PRESS RETURN FOR CONTINUE"
1180       ' --- CURSOR POSITIONING & INPUT DATA ---
1190       VTAB  5 : HTAB 40 : INPUT "",PB
1200       VTAB  6 : HTAB 40 : INPUT "",PC
1210       VTAB  7 : HTAB 40 : INPUT "",PD
1220       VTAB 12 : HTAB 17 : INPUT "",PE
1230       VTAB 12 : HTAB 33 : INPUT "",PF
1240       VTAB 12 : HTAB 51 : INPUT "",PG
1250       VTAB 14 : HTAB 17 : INPUT "",PH
1260       VTAB 14 : HTAB 51 : INPUT "",PI
1270       VTAB 16 : HTAB 17 : INPUT "",PJ
1273       IF PJ=0 THEN 1275 ELSE 1280
1275       VTAB 16 : HTAB 65 : INPUT "",PN : GOTO 1300
1280       VTAB 16 : HTAB 51 : INPUT "",PK
1300 ' --- PROCESSING ---
1310 PL=(PE+PF)*(PC/PD)*PG
1320 PM=PH*(PC/PD)*PI
1325 IF PJ=0 THEN 1340
1330 PN=PJ*(PC/PD)*PK
1340 PO=PL+PM+PN
1350 PP=PO/PB
1400          ' --- CURSOR POSITIONING & OUTPUT DATA ---
1410          VTAB 12 : HTAB 65 : PRINT "";PL
1420          VTAB 14 : HTAB 65 : PRINT "";PM
1430          VTAB 16 : HTAB 65 : PRINT "";PN
1440          VTAB 19 : HTAB 65 : PRINT "";PO
1450          VTAB 20 : HTAB 65 : PRINT "";PP
1460          VTAB 23 : HTAB 65 : INPUT "",AA
1470          IF AA=1 THEN 1000
1480          IF AA=9 THEN 1490 ELSE 2000
1490          CHAIN "STRUCT.TXT"
```

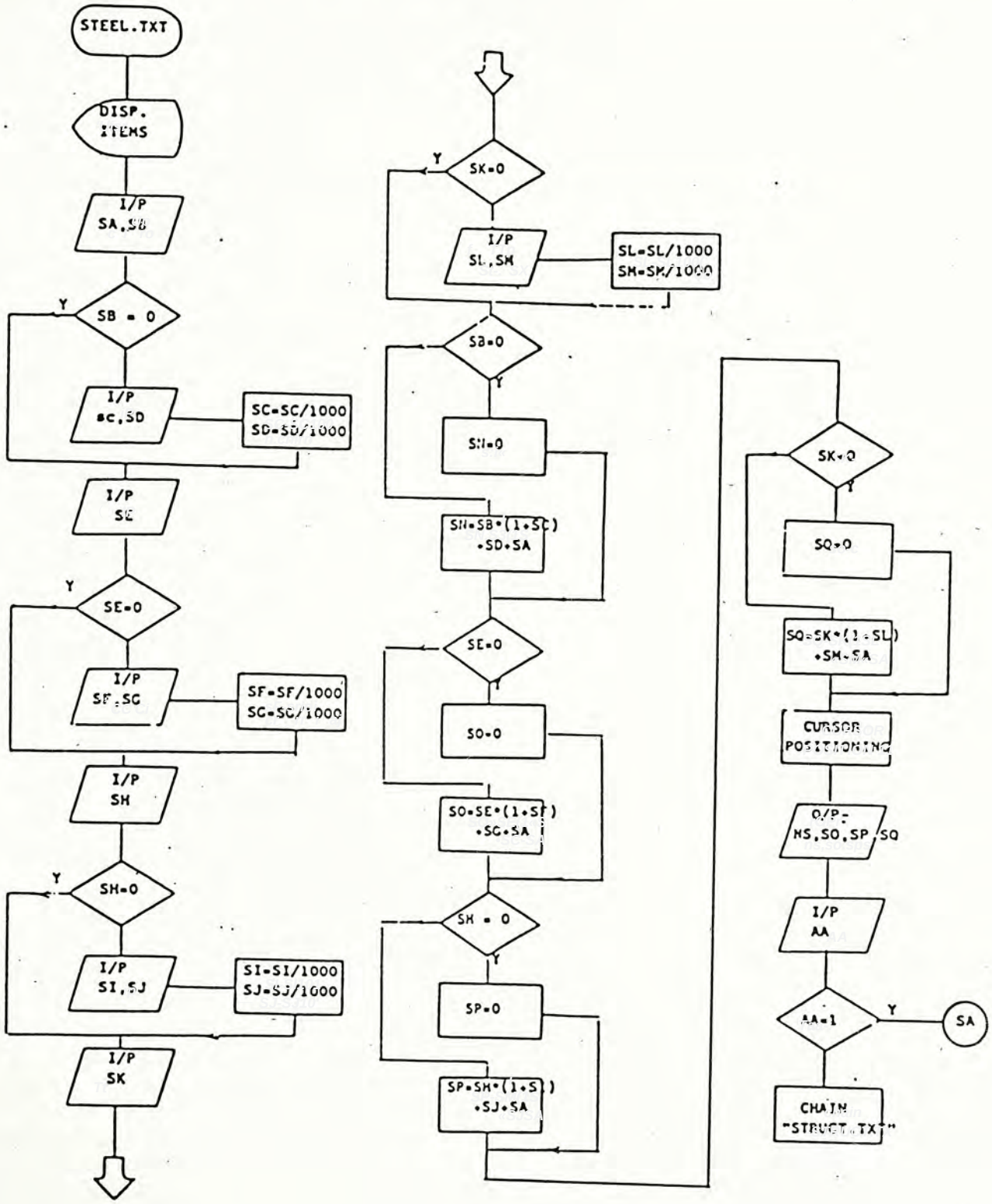
```
2000 HOME : ' --- CONCRETE ---
2010 PRINT TAB(30) "* MATERIAL -- CONCRETE *" : PRINT TAB(30) "------------------------"
2020 PRINT : PRINT "## CONCRETE TYPES AVAILABLE :"
2030 PRINT : PRINT TAB(20) "(1)  7/20
2040 PRINT TAB(20) "(2)  10/20"
2050 PRINT TAB(20) "(3)  20/20"
2060 PRINT TAB(20) "(4)  30/20"
2070 PRINT TAB(20) "(5)  45/20"
2080 PRINT TAB(20) "(6)  45/10"
2090 PRINT TAB(20) "(7)  LEAN CONCRETE"
2100 PRINT TAB(20) "(8)  NO FINE CONCRETE" SPC(20) "## CHOICE :"
2110 PRINT : PRINT "## TOTAL QUANTITY (IN CU. METER) --";MA
2120 PRINT "## CONTRACT DURATION (IN MONTH)  --";MB
2130 PRINT "## USE ICE WATER (Y/N)           --"
2140 PRINT : PRINT OF CONCRETE DATA ---
2260       IF CA=1 THEN 2270 ELSE 2280
2270       CC$="7/20 CONC." : C1=180 : C2=1211.86 : C3=842.14 : C4=126 : C5=3 : GOTO 2450
2280       IF CA=2 THEN 2290 ELSE 2300
2290       CC$="10/20 CONC." : C1=190 : C2=1206.85 : C3=838.655 : C4=125.4 : C5=3 : GOTO 2450
2300       IF CA=3 THEN 2310 ELSE 2320
2310       CC$="20/20 CONC." : C1=290 : C2=1072.33 : C3=745.175 : C4=192.5 : C5=3 : GOTO 2450
2320       IF CA=4 THEN 2330 ELSE 2340
2330       CC$="30/20 CONC." : C1=350 : C2=1072.33 : C3=745.175 : C4=192.5 : C5=3 : GOTO 2450
2340       IF CA=5 THEN 2350 ELSE 2360
2350       CC$="45/20 CONC." : C1=500 : C2=964.65 : C3=670.35 : C4=225 : C5=3 : GOTO 2450
2360       IF CA=6 THEN 2370 ELSE 2380
2370       CC$="45/10 CONC." : C1=520 : C2=947.5 : C3=658.46 : C4=234 : C5=3 : GOTO 2450
2380       IF CA=7 THEN 2390 ELSE 2400
2390       CC$="LEAN CONC." : C1=105 : C2=1305.67 : C3=907.33 : C4=42 : C5=3 : GOTO 2450
2400       IF CA=8 THEN 2410 ELSE 2450
2410       CC$="NO FINE CONC." : C1=190 : C2=1224.25 : C3=850.75 : C4=95 : C5=3
2450       IF CB$="Y" THEN 2460 ELSE 2500
2460       C4=C4-CC
2500          HOME : ' --- SCREEN FORMATTING OF P.2 ---
2510          PRINT TAB(30) "* MATERIAL -- CONCRETE *" : PRINT TAB(30) "------------------------"
2520          PRINT : PRINT "## CONCRETE TYPE SELECTED -- ";CC$
2530          PRINT : PRINT "## CHECK THE MATERIAL QUANTITY BEFORE YOU ENTER DATA !"
2540          PRINT "   ANY CORRECTION (Y/N) --" : PRINT
2550          PRINT "MATERIAL      QUANTITY     CORRECTION       COST      WASTAGE %    RATE COST"
2560          PRINT "--------      --------     ----------       ------    ---------    ---------"
2570          PRINT "CEMENT" SPC(7) C1;"Kg"
2580          PRINT "C. AGG." SPC(6) C2;"Kg"
2590          PRINT "F. AGG." SPC(6) C3;"Kg"
2600          PRINT "WATER" SPC(8) C4;"LITER"
2610          PRINT "ADDITIVE" SPC(5) C5;"LITER"
2620          PRINT STRING$ (78,"*")
2630          PRINT : PRINT TAB(32) "## BASIC RATE / CU. METER CONC. -- $"
2640          PRINT TAB(32) "## MONTHLY PRODUCTION (IN CU.M) --"
2650          PRINT TAB(32) "## CONC. COST / MONTH          -- $"
2660          PRINT STRING$ (78,"-")
2670          PRINT "## PRESS '1' FOR RE-ENTER"
2680          PRINT "## PRESS '9' FOR EXIT"
2690          FOR I=11 TO 15
2700            VTAB I : HTAB 44 : PRINT "$"
2710            VTAB I : HTAB 68 : PRINT "$"
2720          NEXT I
```

```
2740      ' --- CURSOR POSITIONING & INPUT DATA ---
2750      VTAB 7 : HTAB 28 : INPUT "",CD$
2760      IF CD$="Y" THEN 2770 ELSE 2850
2770      FOR I=11 TO 15
2780        VTAB I : HTAB 28 : PRINT "½"
2790      NEXT I
2800      VTAB 11 : HTAB 30 : INPUT "",C1
2810      VTAB 12 : HTAB 30 : INPUT "",C2
2820      VTAB 13 : HTAB 30 : INPUT "",C3
2830      VTAB 14 : HTAB 30 : INPUT "",C4
2840      VTAB 15 : HTAB 30 : INPUT "",C5
2850      ' --- INPUT COST DATA ---
2860      VTAB 11 : HTAB 46 : INPUT "",CE
2865      VTAB 11 : HTAB 55 : INPUT "",CF : CF=CF/100
2870      VTAB 12 : HTAB 46 : INPUT "",CG
2875      VTAB 12 : HTAB 55 : INPUT "",CH : CH=CH/100
2880      VTAB 13 : HTAB 46 : INPUT "",CI
2885      VTAB 13 : HTAB 55 : INPUT "",CJ : CJ=CJ/100
2890      VTAB 14 : HTAB 46 : INPUT "",CK
2895      VTAB 14 : HTAB 55 : INPUT "",CL : CL=CL/100
2900      VTAB 15 : HTAB 46 : INPUT "",CM
2905      VTAB 15 : HTAB 55 : INPUT "",CN : CN=CN/100
3100 ' --- PROCESSING ---
3110 CO=C1*CE*(1+CF)
3120 CP=C2*CG*(1+CH)
3130 CQ=C3*CI*(1+CJ)
3140 CR=C4*CK*(1+CL)
3150 CS=C5*CM*(1+CN)
3155 C6=CC*CQ
3160 CT=CO+CP+CQ+CR+CS+C6
3170 CU=MA/MB
3180 CV=CU*CT
3190          ' --- CURSOR POSITIONING & OUTPUT DATA ---
3200          VTAB 11 : HTAB 69 : PRINT CO
3210          VTAB 12 : HTAB 69 : PRINT CP
3220          VTAB 13 : HTAB 69 : PRINT CQ
3230          VTAB 14 : HTAB 69 : PRINT CR
3240          VTAB 15 : HTAB 69 : PRINT CS
3250          VTAB 18 : HTAB 68 : PRINT CT
3260          VTAB 19 : HTAB 66 : PRINT CU
3270          VTAB 20 : HTAB 68 : PRINT CV
3280      ' --- ASK FOR CONTINUE ---
3290      VTAB 23 : HTAB 30 : INPUT "",AA
3300      IF AA=1 THEN 2500
3410      CHAIN "STRUCT.TXT"
```

Appendix VIII

Steel

(A) Flow Chart



```
CODE? C970
4000 HOME : ' --- STEEL - BENDING & FIXING ---
4010 PRINT TAB(25) "* STEEL - BENDING & FIXING *" : PRINT TAB(25) "-------------------------"
4020 PRINT : PRINT "## INTERNAL TRANSPORTATION ($/TON) : $"
4030 PRINT : PRINT : PRINT "STEEL" SPC(12) "COST" SPC(10) "WASTAGE" SPC(10) "BEND & FIX" SPC(10) "RATE"
4040 PRINT "TYPE" SPC(12) "($/TON)" SPC(8) "(IN %)" SPC(11) "($/PICUL)" SPC(10) "($/TON)
4050 PRINT "-----" SPC(11) "-------" SPC(8) "--------" SPC(10) "----------" SPC(9) "-------"
4055 PRINT : PRINT "HT 20 UP" SPC(8) "$" SPC(31) "$" SPC(18) "$"
4060 PRINT : PRINT "HT 16 DN" SPC(8) "$" SPC(31) "$" SPC(18) "$"
4070 PRINT : PRINT "MS 20 UP" SPC(8) "$" SPC(31) "$" SPC(18) "$"
4080 PRINT : PRINT "MS 16 DN" SPC(8) "$" SPC(31) "$" SPC(18) "$"
4095 PRINT
4100 PRINT
4110 PRINT STRING$ (78,"-")
4120 PRINT "## PRESS '1' FOR RE-ENTER"
4125 PRINT "## PRESS RETURN FOR CONTINUE" SPC(20) "## CHOICE :"
4140    ' --- CURSOR POSITIONING & INPUT DATA ---
4145    VTAB  4 : HTAB 40 : INPUT "",SA
4150    VTAB 11 : HTAB 19 : INPUT "",SB
4155    IF SB=0 THEN 4180
4160    VTAB 11 : HTAB 32 : INPUT "",SC : SC=SC/100
4170    VTAB 11 : HTAB 51 : INPUT "",SD : SD=SD/60.5
4180    VTAB 13 : HTAB 19 : INPUT "",SE
4185    IF SE=0 THEN 4210
4190    VTAB 13 : HTAB 32 : INPUT "",SF : SF=SF/100
4200    VTAB 13 : HTAB 51 : INPUT "",SG : SG=SG/60.5
4210    VTAB 15 : HTAB 19 : INPUT "",SH
4215    IF SH=0 THEN 4240
4220    VTAB 15 : HTAB 32 : INPUT "",SI : SI=SI/100
4230    VTAB 15 : HTAB 51 : INPUT "",SJ : SJ=SJ/60.5
4240    VTAB 17 : HTAB 19 : INPUT "",SK
4245    IF SK=0 THEN 4280
4250    VTAB 17 : HTAB 32 : INPUT "",SL : SL=SL/100
4260    VTAB 17 : HTAB 51 : INPUT "",SM : SM=SM/60.5
4280          ' --- PROCESSING ---
4290          IF SB=0 THEN 4300 ELSE 4310
4300          SN=0 : GOTO 4320
4310          SN=SB*(1+SC)+SD+SA
4320          IF SE=0 THEN 4330 ELSE 4340
4330          SO=0 : GOTO 4350
4340          SO=SE*(1+SF)+SG+SA
4350          IF SH=0 THEN 4360 ELSE 4370
4360          SP=0 : GOTO 4380
4370          SP=SH*(1+SI)+SJ+SA
4380          IF SK=0 THEN 4390 ELSE 4400
4390          SQ=0 : GOTO 4410
4400          SQ=SK*(1+SL)+SM+SA
4410 ' --- CURSOR POSITIONING & OUPUT DATA ---
4420 VTAB 11 : HTAB 69 : PRINT "";SN
4430 VTAB 13 : HTAB 69 : PRINT "";SO
4440 VTAB 15 : HTAB 69 : PRINT "";SP
4450 VTAB 17 : HTAB 69 : PRINT "";SQ
4460    ' --- ASK FOR CONT ---
4470    VTAB 22 : HTAB 61 : INPUT "",AA
4500       ' --- CHECKING AA ---
4510       IF AA=1 THEN 4000
4520       CHAIN "STRUCT.TXT"
4999 INPUT "",AA
```

Appendix IX

Drainage Programme

(A) How to use / Function

H O W T O U S E

1. SWITCH ON THE COMPUTER
2. SWITCH ON THE MONITOR
3. INSERT THE DISK INTO THE DISK DRIVE WHILE THE IN-USE LAMP IS ON.
4. CLOSE THE DRIVE DOOR
5. USE 'DIR' TO CHECK WHETHER IT IS THE PROPER DISK
6. TYPE IN 'MBASIC'
7. WAIT FOR A WHILE UNTIL 'OK' IS DISPLAYED
8. TYPE IN 'LOAD DRAIN-6.TXT' TO LOAD THE DRAIN-6 FROM DISK TO CPU
9. WAIT FOR A WHILE UNTIL 'OK' IS DISPLAYED
10. TYPE IN 'RUN', THEN DRAIN-6 IS STARTED
11. YOU MAY RENEW A PAGE OR RE-ENTER BY PRESSING '5' AT EACH END OF PAGE.
12. YOU MAY EXIT THIS PROGRAM BY PRESSING '9' AT THE END OF PAGE ONE AND PAGE FIVE.
13. YOU MAY RESTART THIS PROGRAM BY PRESSING '7' AT PAGE FIVE.

FUNCTIONS

A) Two types of bedding :

(1) Whole surround

(2) Half surround

B) Two choices of bedding thickness :

(1) Vary with internal diameter

(2) Vary with external diameter

(C) Two choices of conc. thickness :

(1) Vary with internal diameter

(2) Vary with external diameter

D) Two choices of conc. cover thickness :

(1) Vary with internal diameter

(2) Vary with external diameter

E) For trench width is specified in a drawing, two choices are available :

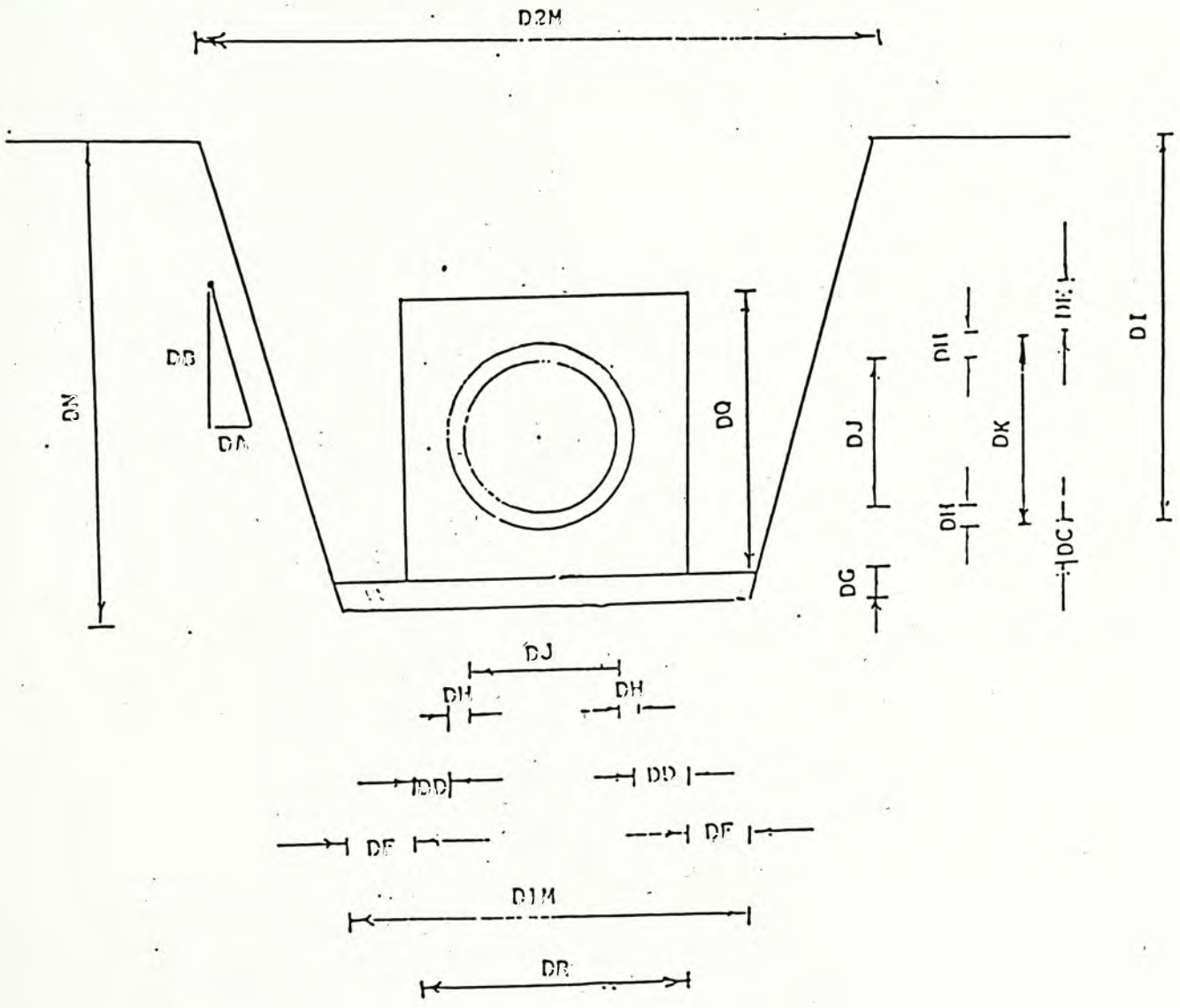
(1) Vary with internal diameter

(2) Vary with external diameter

** Numeric dimensions are created instantly for holding the corresponding trench width.

(B) Calculation

DIMENSION VARIABLES FOR WHOLE SURROUND BEDDING TYPE



CALCULATION FORMULA FOR WHOLE SURROUND BEDDING TYPE

** EXCAVATION VOLUME :

DN = DI + DH + DG + DG
D1M =DJ +2 * (DH + DD + DF)
D2M =D1M + (DN * (DA / DB))
VA = ((D1M + D2M) * DN / 2)

** PIPE VOLUME :

DK = DJ + 2 * DH
VI = 3.14159 * (DK / 2)^2

** BEDDING VOLUME :

DR = DJ + 2 * (DH + DD)
DQ = DE + DJ + 2 * DH + DC
VB = DR * DQ - VI

** BLINDING VOLUME :

VC = D1M * DG

** FORM WORK AREA :

VE = DQ * 1 * 2

** STEEL :

VH = DOST * VB

SAST = VH * 7800

** FILTER AREA :

VG VG = (1 * 2 * DQ) + (DR * 1)

** BACK FILL VOLUME :

VD = VA - VB - VC - VI - VF

RATE COST CALCULATION FOR WHOLE SURROUND BEDDING TYPE

EXCAVATION = EXCAVATION VOL. * COST OF EXCAVATION

20/20 CONC. = BEDDING VOL. * COST OF 20/20 CONC.

7/20 CONC. = BLINDING VOL. * COST OF 7/20 CONC.

BACK FILL = BACK FILL VOL. * COST OF BACK FILL

FORM WORK = FORM WORK AREA * COST OF FORM WORK

AGGREGATE = AGGREGATE VOL. * COST OF AGGREGATE

FILTER = FILTER AREA * COST OF FILTER

STEEL = STEEL VOL. * COST OF STEEL

PIPE LAYING = COST OF PIPE LAYING

PIPE COST = COST OF PIPE

EXCAVATION : RA = VA * CA

20/20 conc. : RB = VB * CB

7/20 conc. : RC = VC * CC

BACK FILL : RD = VD * CD

FORM WORK : RE = VE * CE

AGGREGATE : RF = VF * CF

FILTER : RG = VG * CG

STEEL : RH = SAST * CH / 1000

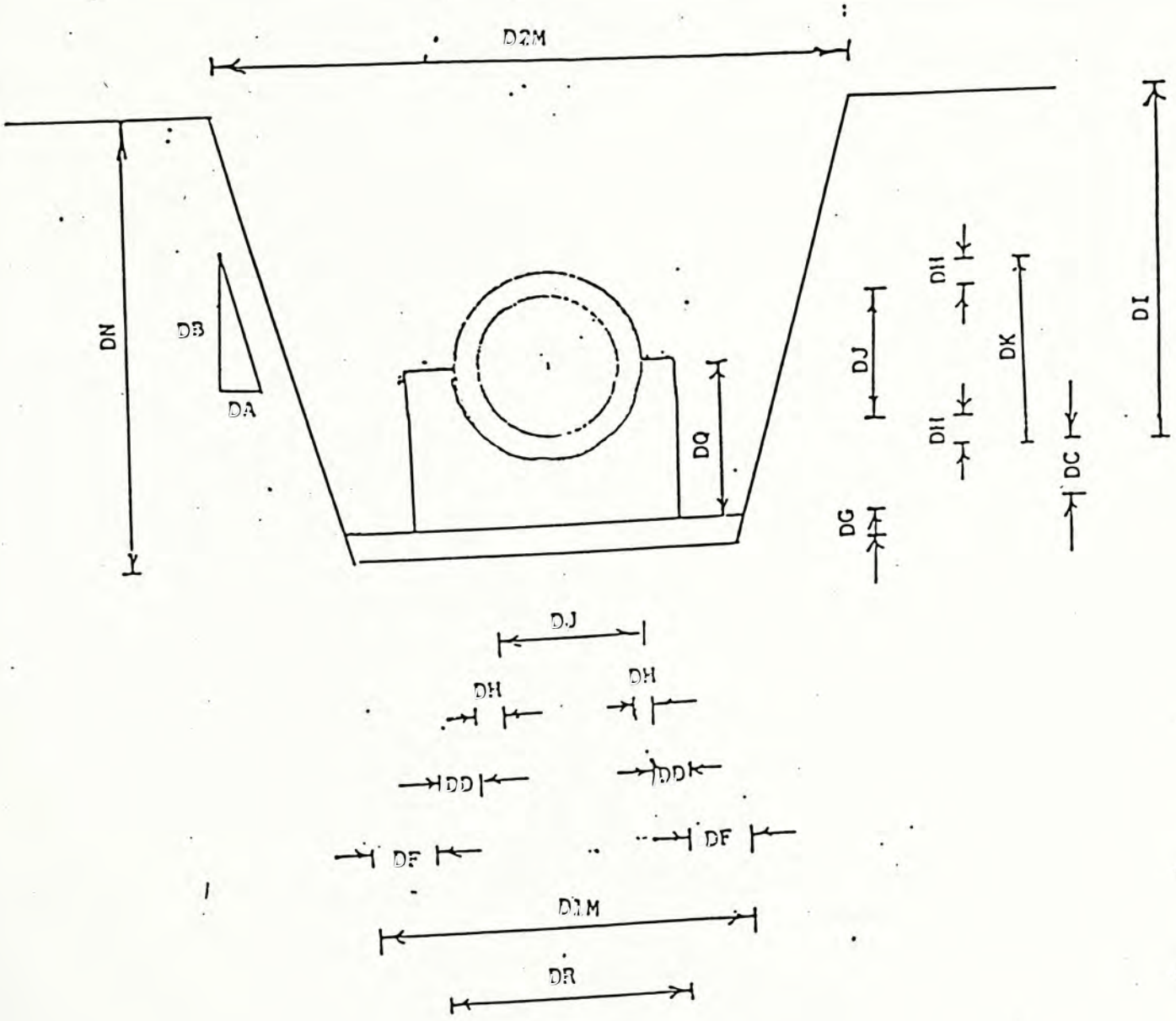
PIPE LAYING : RI = DJ * DP

PIPR COST : RJ = CJ

BASIC RATE : RZ = RA+RB+RC+RD+RE+RF+RG+RH+RI+RJ

Appendix IX - B4

DIMENSION VARIABLES FOR HALF SURROUND BEDDING TYPE



CALCULATION FORMULA FOR HALF SURROUND BEDDING TYPE

** EXCAVATION VOLUME :

DN = DI + DH + DC + DG
D1M =DJ +2 * (DH + DD + DF)
D2M =D1M + (DN * (DA / DB))
VA = ((D1M + D2M) * DN / 2)

** PIPE VOLUME :

DK = DJ + 2 * DH
VI = 3.14159 * (DK / 2)^2

** BEDDING VOLUME :

DR = DJ + 2 * (DH + DD)
DQ = DE + DJ + 2 * DH + DC
VB = DR * DQ - VI

** BEDDING VOLUME :

DR = DJ + 2 * (DH + DD)
DQ = DK/2 +DC
VB = (DR * DQ) - VI

VE = DQ * 1 * 2

** STEEL :

VH = DOST * VB

SAST = VH * 7800

** FILTER AREA :

VG VG = (1 * 2 * DQ) + (DR * 1)

** BACK FILL VOLUME :

VD = VA - VB - VC - VI - VF

RATE COST CALCULATION FOR HALF SURROUND BEDDING TYPE

EXCAVATION = EXCAVATION VOL. * COST OF EXCAVATION

20/20 CONC. = BEDDING VOL. * COST OF 20/20 CONC.

7/20 CONC. = BLINDING VOL. * COST OF 7/20 CONC.

BACK FILL = BACK FILL VOL. * COST OF BACK FILL

FORM WORK = FORM WORK AREA * COST OF FORM WORK

AGGREGATE = AGGREGATE VOL. * COST OF AGGREGATE

FILTER = FILTER AREA * COST OF FILTER

STEEL = STEEL VOL. * COST OF STEEL

PIPE LAYING = COST OF PIPE LAYING

PIPE COST = COST OF PIPE

EXCAVATION : RA = VA * CA

20/20 conc. : RB = VB * CB

7/20 conc. : RC = VC * CC

BACK FILL : RD = VD * CD

FORM WORK : RE = VE * CE

AGGREGATE : RF = VF * CF

FILTER : RG = VG * CG

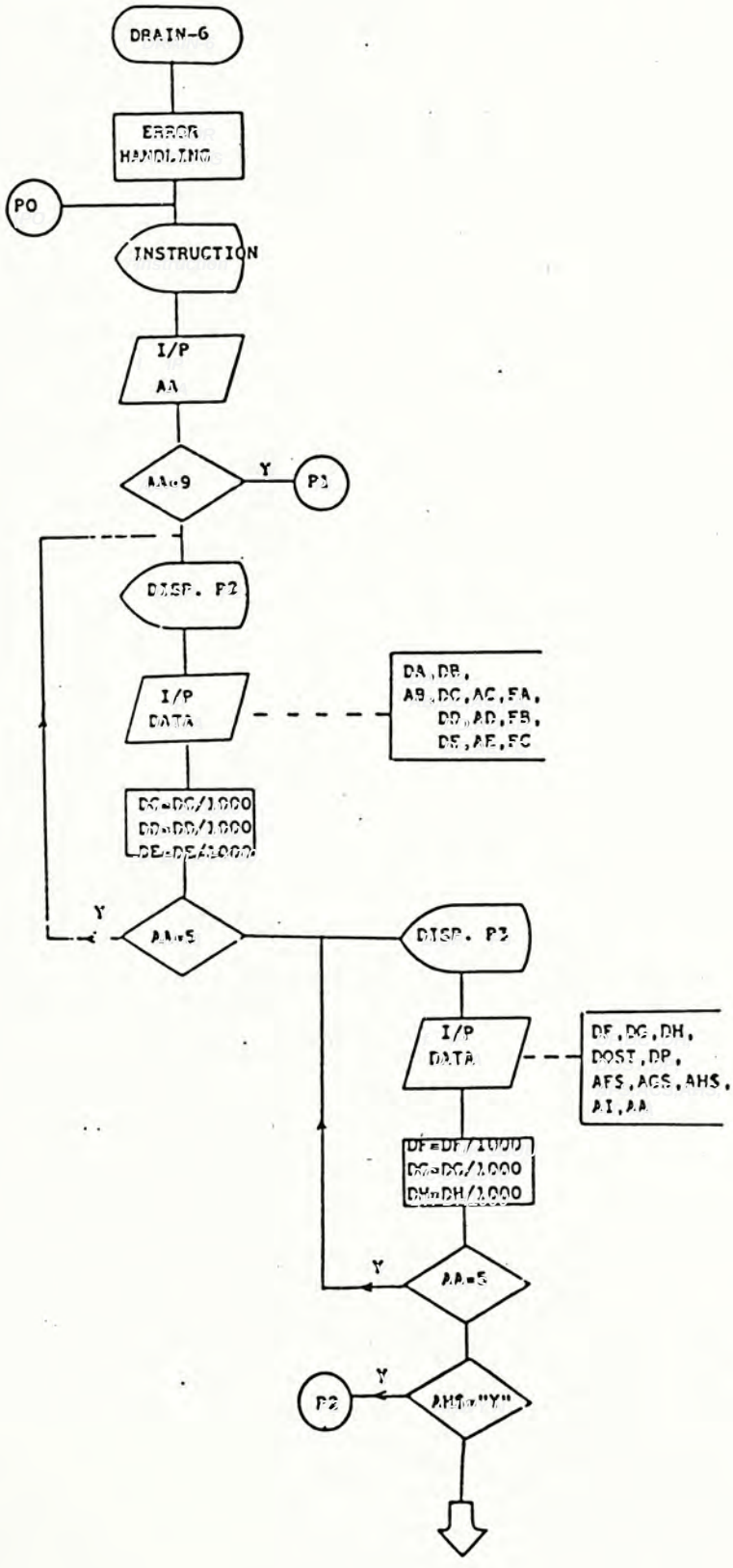
STEEL : RH = SAST * CH / 1000

PIPE LAYING : RI = DJ * DP

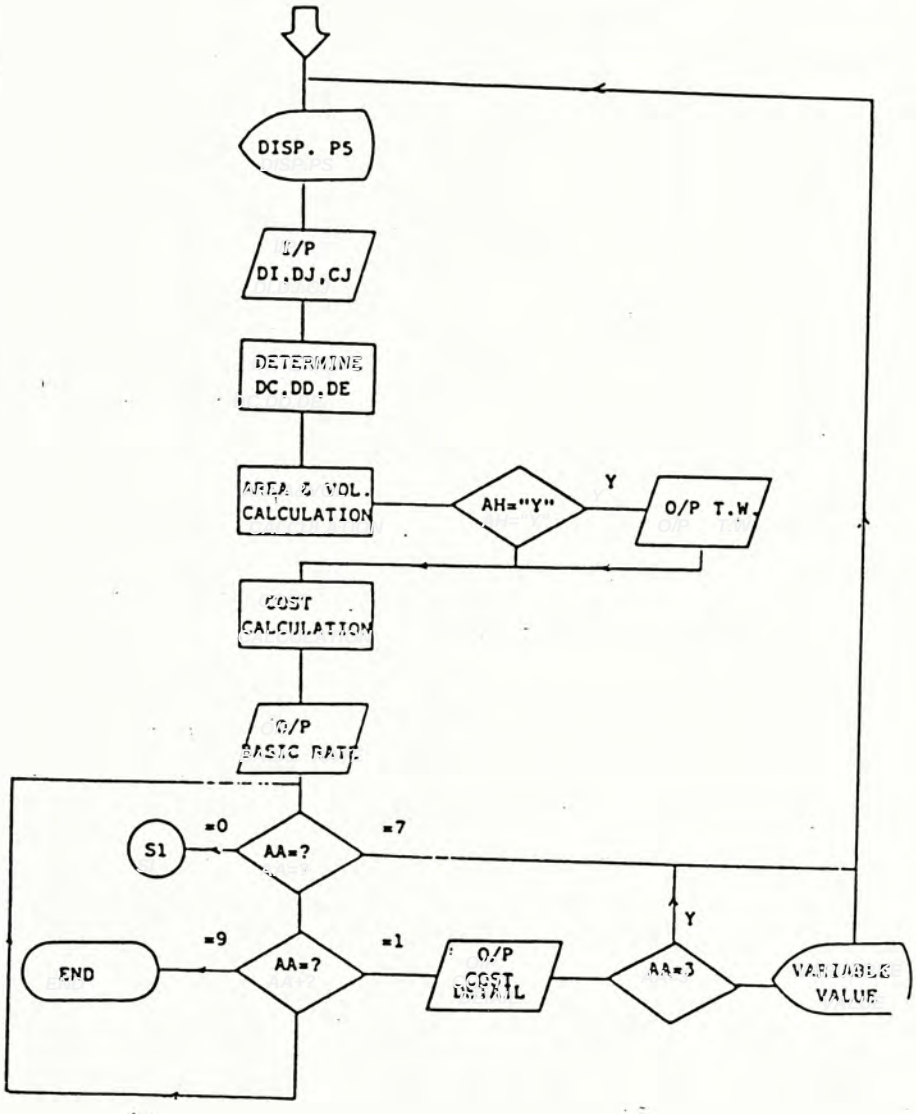
PIPE COST : RJ = CJ

BASIC RATE : RZ = RA+RB+RC+RD+RE+RF+RG+RH+RI+RJ

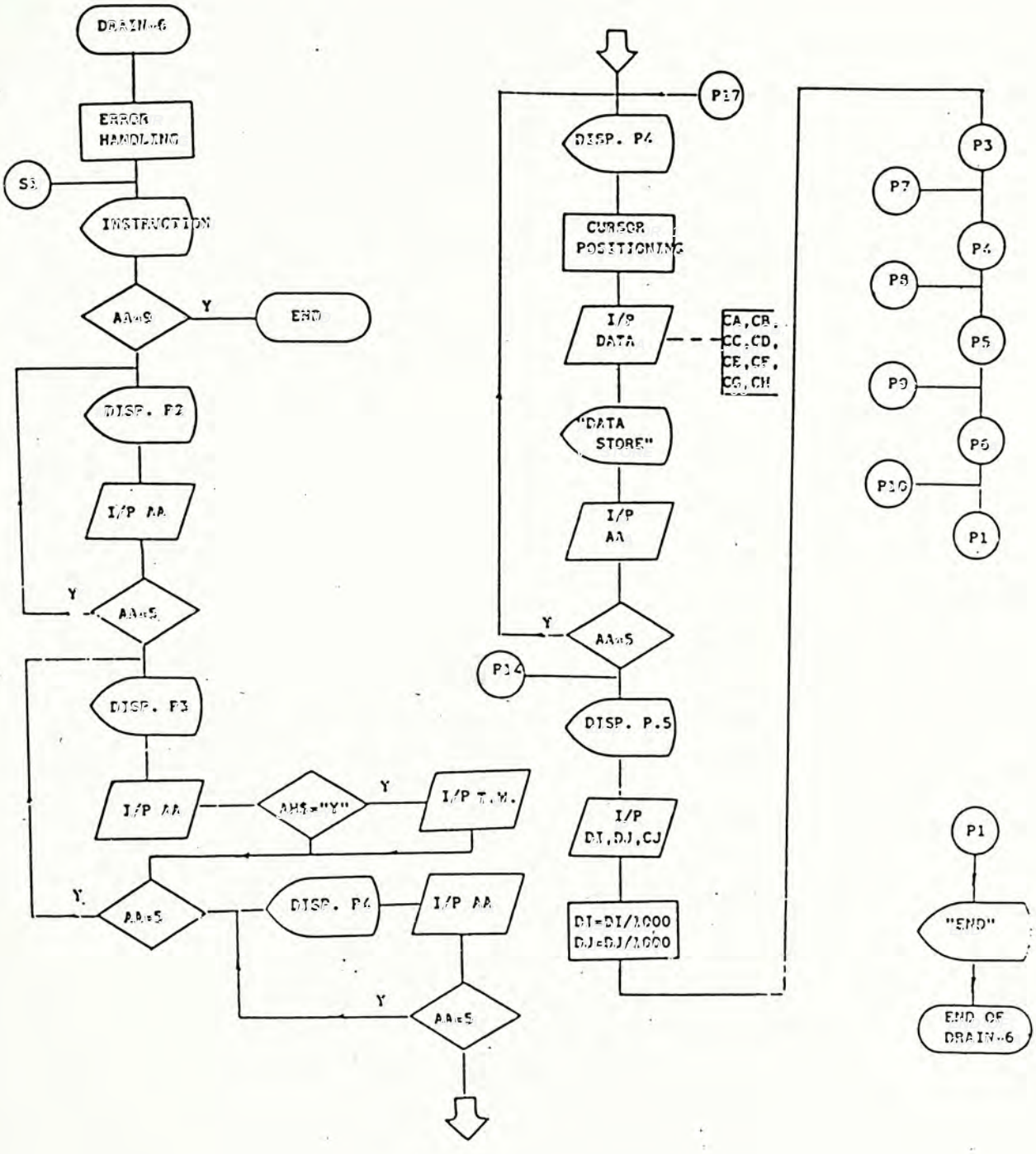
(C) Programme Flow Charts



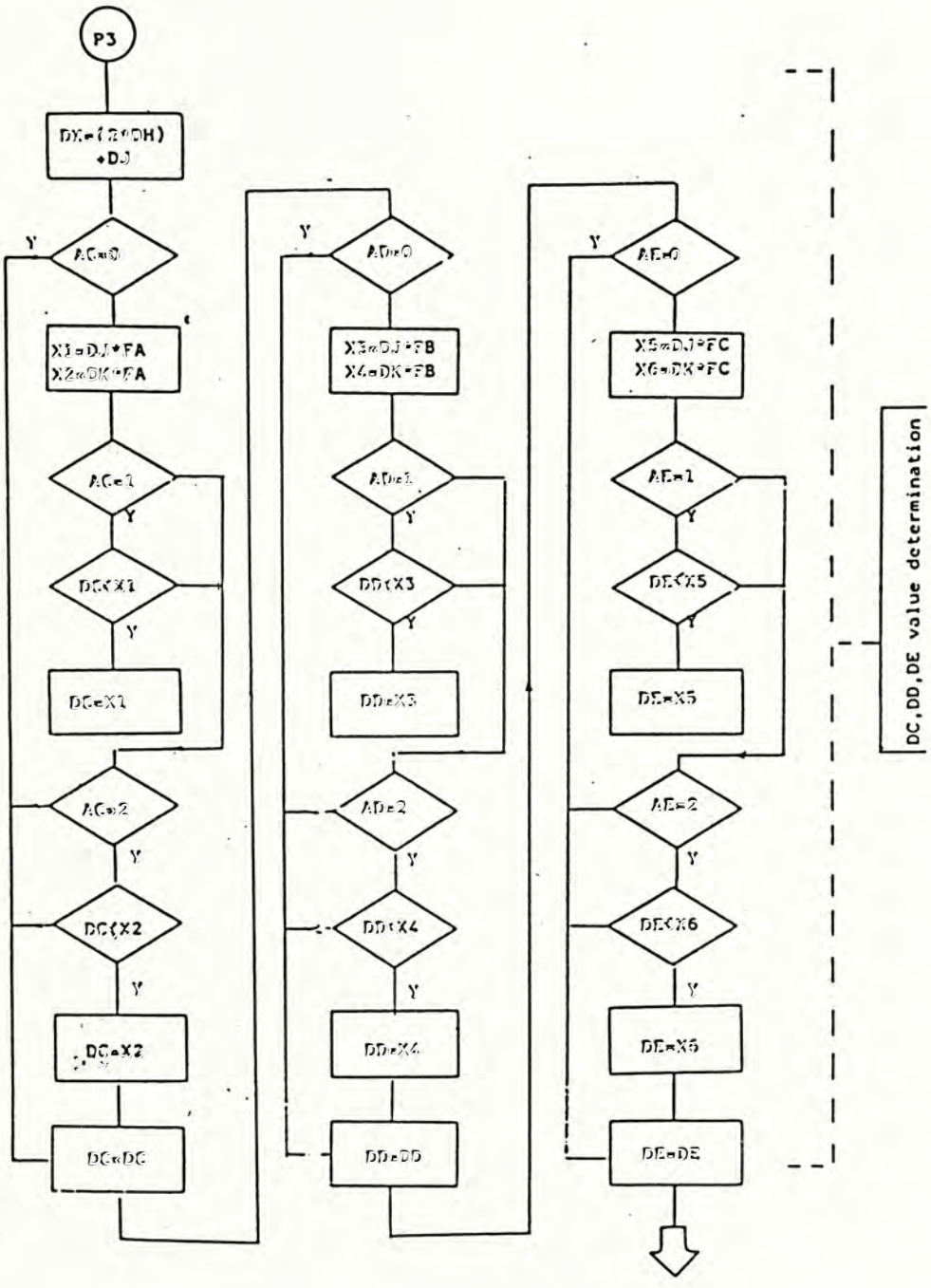
Appendix IX - C2



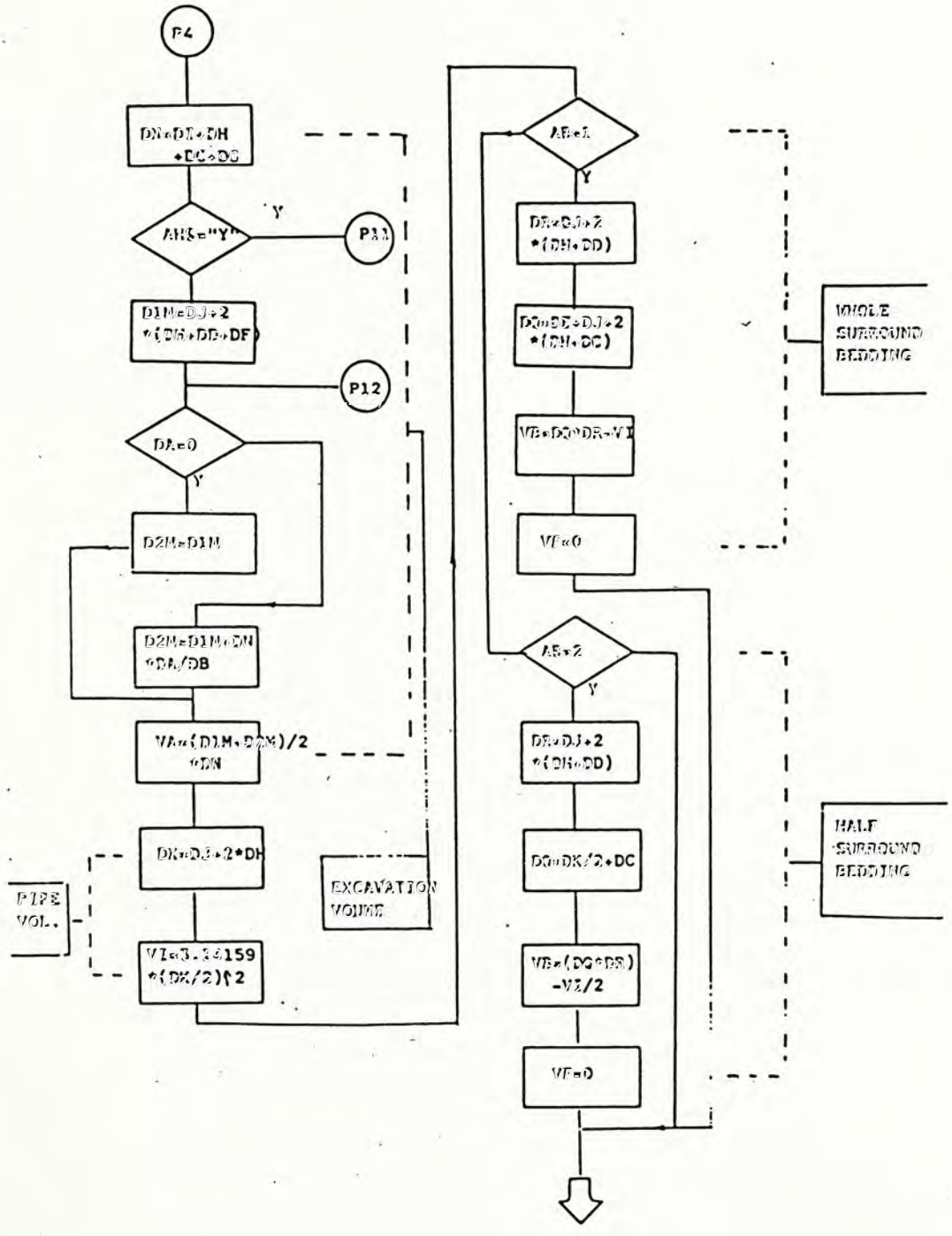
Appendix IX - C3



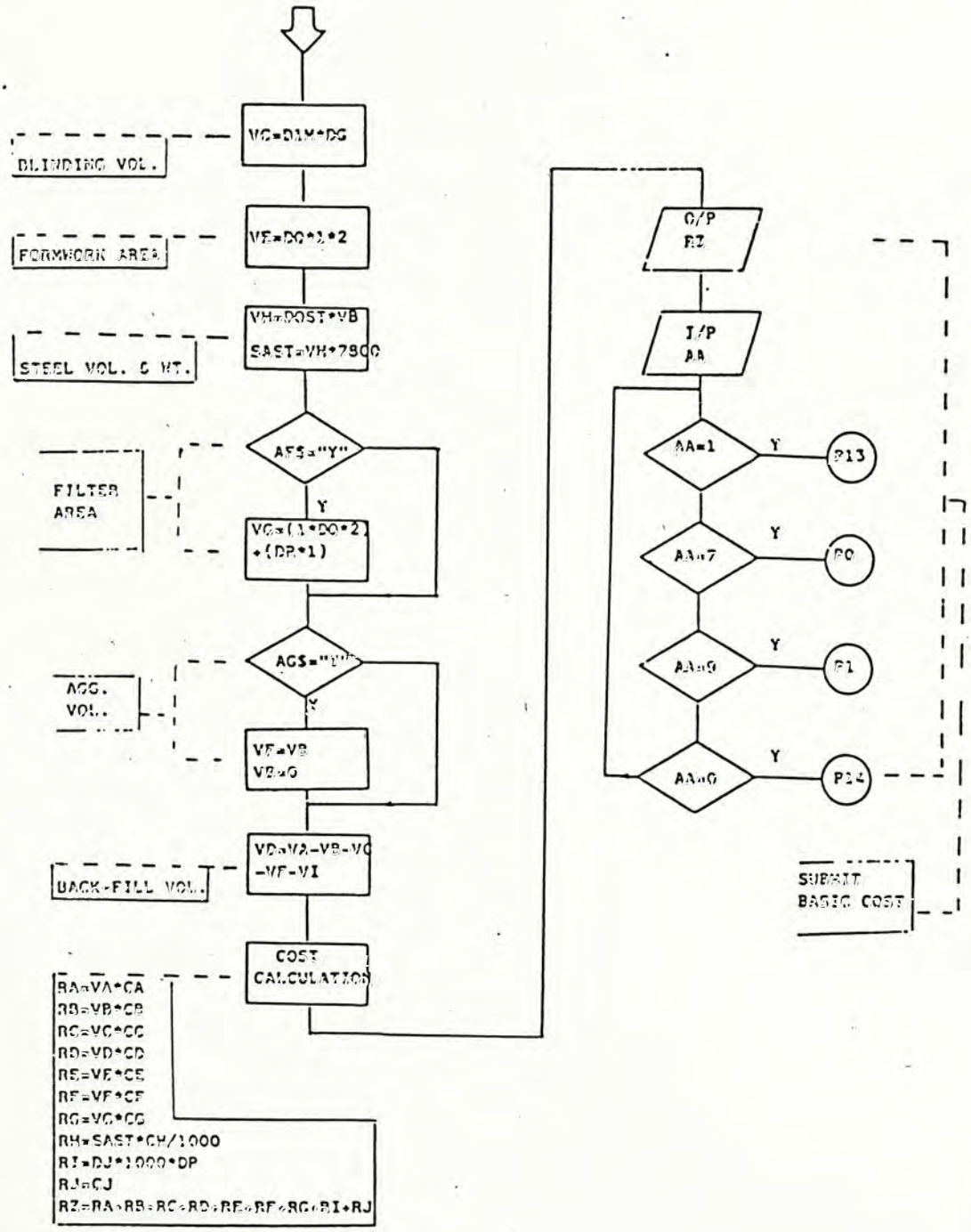
Appendix IX - C4



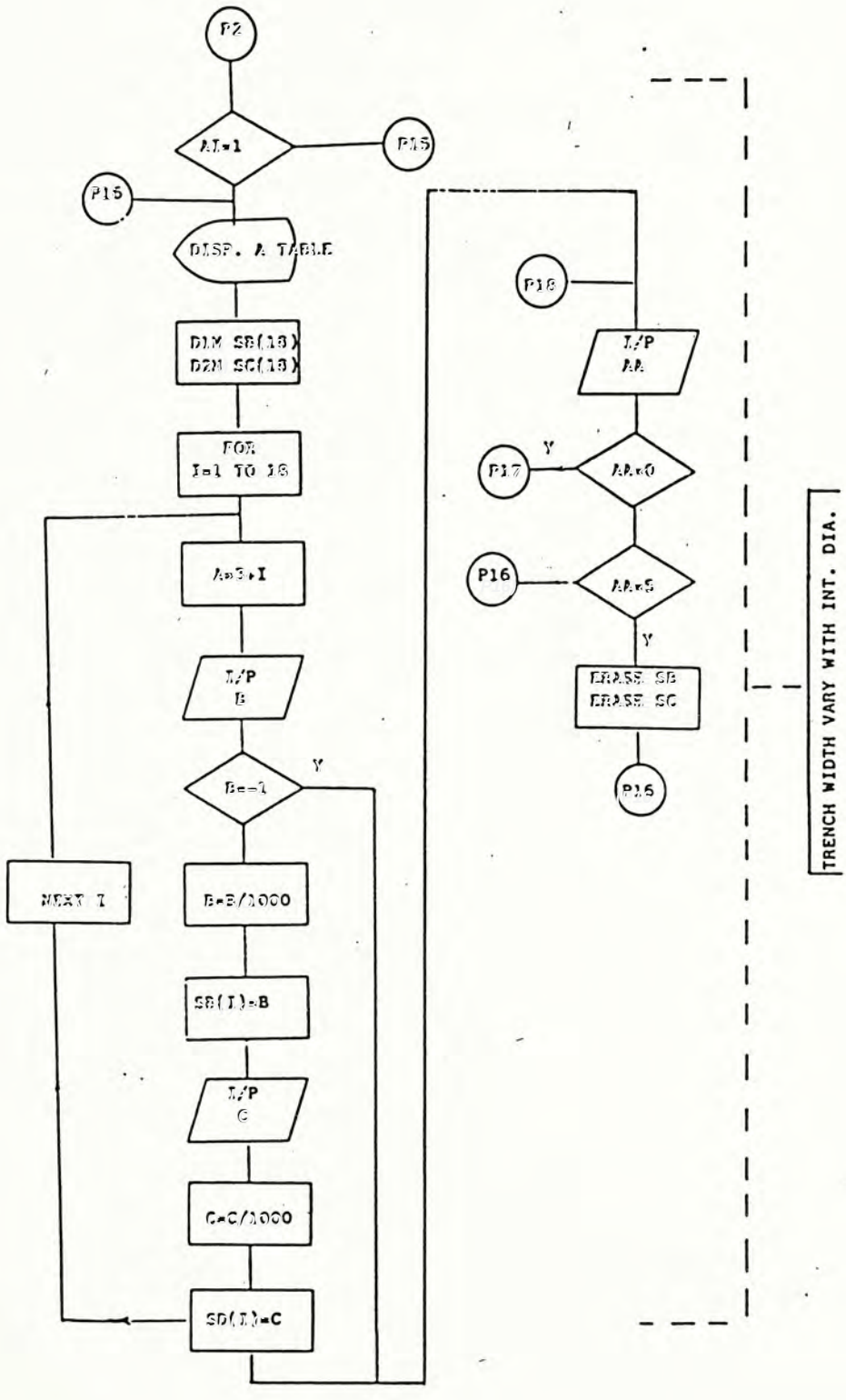
Appendix IX - C5



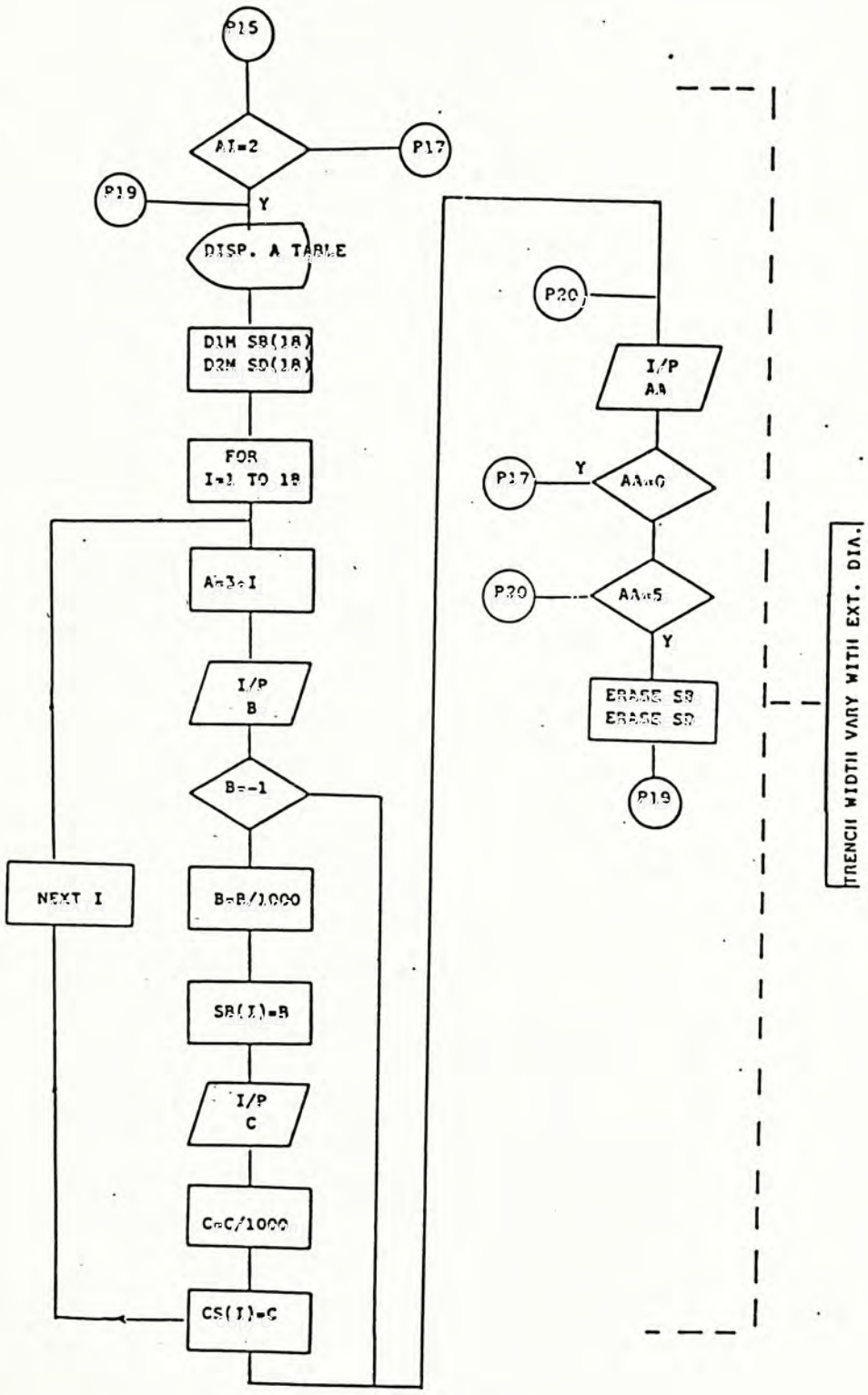
Appendix IX - C6



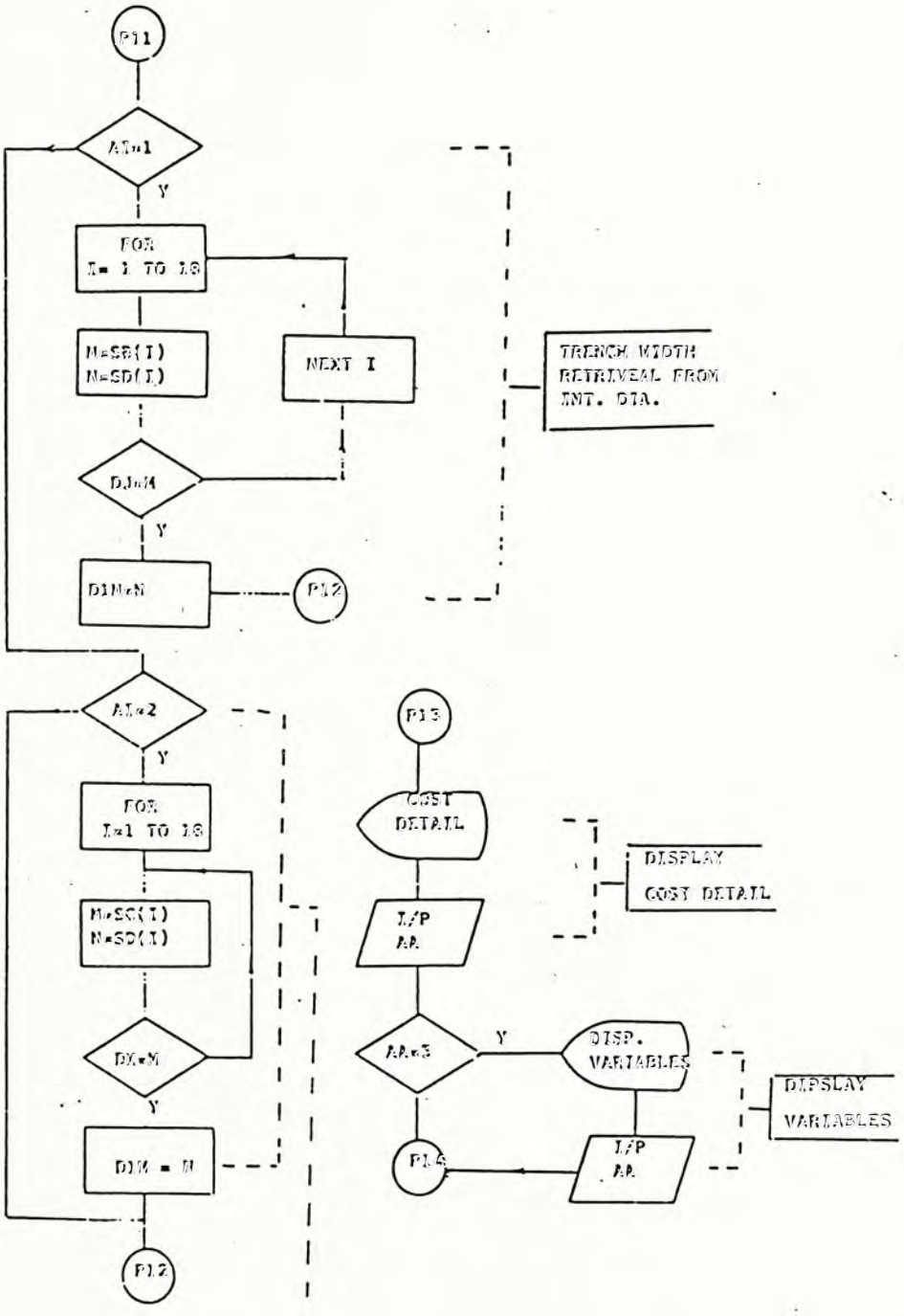
Appendix IX - C7



Appendix IX - C8



Appendix IX - C9



(D) Program

```
100 HOME : ' --- DISPLAY INSTRUCTIONS ---
105 PRINT TAB(27) "---- INSTRUCTION ----"
110 PRINT TAB(27) "----------------------"
115 PRINT
120 PRINT TAB(5) "(1) ALL DIMENSION SHOULD BE ENTERED IN mm."
125 PRINT : PRINT TAB(5) "(2) YOU MAY RENEW A PAGE BY PRESSING '5' AT THE PAGE END."
130 PRINT : PRINT TAB(5) "(3) CHOICE KEYS :"
135 PRINT : PRINT TAB(10) "'1' FOR COST DETAIL"
140 PRINT TAB(11) "'3' FOR VARIABLE VALUES"
145 PRINT TAB(12) "'5' FOR RENEW A PAGE"
150 PRINT TAB(13) "'7' FOR RESTART THIS PROGRAM"
155 PRINT TAB(14) "'9' FOR EXIT"
160 PRINT TAB(15) "'RETURN' FOR CONTINUE"
170 PRINT
200 PRINT
210 PRINT
220 PRINT
230 PRINT
240 PRINT
250 PRINT STRING$ (78,"-")
260 PRINT "## PRESS RETURN FOR CONTINUE"
270 INPUT "## PRESS '9' FOR EXIT                                    CHOICE : ",AA
280 IF AA-9 THEN 1910
300    HOME : ' --- SCREEN FORMAT FOR Q(A) TO Q(E) ---
310    PRINT TAB(25) "---- DRAIN-6 PROGRAM ----"
320    PRINT TAB(25) "------------------------"
330    PRINT
340    PRINT TAB(10) "(A) SLOPE OF EXCAVATION H:V                    ##    TO"
345    PRINT
350    PRINT TAB(10) "(B) CHOICE OF BEDDING SHAPE :"
360    PRINT TAB(15) "(1) WHOLE SURROUND"
370    PRINT TAB(17) "(2) HALF  SURROUND"
380    PRINT TAB(19) "                                    ## CHOICE :""
390    PRINT
400    PRINT TAB(10) "(C) MIN. BED'G THICKNESS :" SPC(24) "##"
410    PRINT TAB(20) "(1) VARY WITH INT. DIA.              ## CHOICE :"
420    PRINT TAB(20) "(2) VARY WITH EXT. DIA.              ## FACTOR :"
430    PRINT
440    PRINT TAB(10) "(D) MIN. SIDE THICKNESS :" SPC(25) "##"
450    PRINT TAB(20) "(1) VARY WITH INT. DIA.              ## CHOICE :"
460    PRINT TAB(20) "(2) VARY WITH EXT. DIA.              ## FACTOR :"
470    PRINT
480    PRINT TAB(10) "(E) MIN. COVER THICKNESS :" SPC(24) "##"
490    PRINT TAB(20) "(1) VARY WITH INT. DIA.              ## CHOICE :"
500    PRINT TAB(20) "(2) VARY WITH EXT. DIA.              ## FACTOR :"
510    PRINT STRING$(78,"-")
520    PRINT "## PRESS RETURN FOR CONTINUE"
550       ' --- CURSOR POSITIONING ---
560       VTAB  4 : HTAB 63 : INPUT "",DA
570       VTAB  4 : HTAB 69 : INPUT "",DB
580       VTAB  9 : HTAB 72 : INPUT "",AB
590       VTAB 11 : HTAB 63 : INPUT "",DC : DC-DC/1000
600       VTAB 12 : HTAB 72 : INPUT "",AC
610       IF AC-0 THEN 630
620       VTAB 13 : HTAB 72 : INPUT "",FA
630       VTAB 15 : HTAB 63 : INPUT "",DD : DD-DD/1000
640       VTAB 16 : HTAB 72 : INPUT "",AD
650       IF AD-0 THEN 670
```

```
660       VTAB 17 : HTAB 72 : INPUT "",FB
670       VTAB 19 : HTAB 63 : INPUT "",DE : DE=DE/1000
680       VTAB 20 : HTAB 72 : INPUT "",AE
690       IF AE=0 THEN 710
700       VTAB 21 : HTAB 72 : INPUT "",FC
710       VTAB 23 : HTAB 30 : INPUT "",AA
720       IF AA=5 THEN 300
750    HOME : ' --- SCREEN FORMAT FOR Q(F) TO Q(I) ---
760    PRINT TAB(25) "==== DRAIN-6 PROGRAM ===="
770    PRINT TAB(25) "------------------------"
780    PRINT
790    PRINT TAB(20) "(F) OTHER DATA :"
800    PRINT
810    PRINT TAB(25) "WORKING SPACE (E.S) --"
820    PRINT TAB(25) "BLINDING THINKNESS  --"
830    PRINT TAB(25) "PIPE THINKNESS      --"
840    PRINT TAB(25) "STEEL VOL. %        --"
850    PRINT TAB(25) "PIPE LAYING %       --"
860    PRINT
870    PRINT TAB(20) "(G) S.F.M. USE ?   (Y/N) --"
880    PRINT
890    PRINT TAB(20) "(H) AGG.   USE ?   (Y/N) --"
900    PRINT
910    PRINT TAB(20) "(I) IS TRENCH WIDTH SPECIFIED ? (Y/N) --"
920    PRINT TAB(25) "(1) VARY WITH INT. DIA."
930    PRINT TAB(25) "(2) VARY WITH EXT. DIA."
940    PRINT TAB(57) "## CHOICE :" : PRINT
950    PRINT STRING$ (78,"-")
960    PRINT "## PRESS RETURN FOR CONTINUE"
1000      ' --- CURSOR POSITIONING ---
1010      VTAB  6 : HTAB 48 : INPUT "",DF : DF=DF/1000
1020      VTAB  7 : HTAB 48 : INPUT "",DG : DG=DG/1000
1030      VTAB  8 : HTAB 48 : INPUT "",DH : DH=DH/1000
1040      VTAB  9 : HTAB 48 : INPUT "",DOST
1050      VTAB 10 : HTAB 48 : INPUT "",DP : DP=DP/100
1060      VTAB 12 : HTAB 48 : INPUT "",AF$
1070      VTAB 14 : HTAB 48 : INPUT "",AG$
1080      VTAB 16 : HTAB 61 : INPUT "",AH$
1090      IF AH$="N" THEN 1110
1100      VTAB 19 : HTAB 69 : INPUT "",AI
1110      VTAB 22 : HTAB 30 : INPUT "",AA
1120      IF AA=5 THEN 750
1130      IF AH$="Y" THEN GOTO 4000
1200    HOME : ' --- SCREEN FORMAT FOR Q(J) ---
1210    PRINT TAB(25) "==== DRAIN-6 PROGRAM ===="
1220    PRINT TAB(25) "------------------------"
1230    PRINT
1240    PRINT
1250    PRINT TAB(10) "(J) COST OF MATERIALS :"
1260    PRINT
1270    PRINT TAB(25) "EXCAVATION (/M3) -- $"
1290    PRINT TAB(25) "20/20 CONC.(/M3) -- $"
1300    PRINT TAB(25) " 7/20 CONC.(/M3) -- $"
1310    PRINT TAB(25) "BACK-FILL  (/M3) -- $"
1320    PRINT TAB(25) "FORM-WORK  (/M2) -- $"
1325    PRINT TAB(25) "AGGREGATE  (/KG) -- $"
1330    PRINT TAB(25) "S.F.M.     (/M3))-- $"
1340    PRINT TAB(25) "STEEL  (PER TON) -- $"
1350    PRINT
1360    PRINT STRING$ (78,"-")
```

```
1400        ' --- CURSOR POSITIONING ---
1410        VTAB  7 : HTAB 47 : INPUT "",CA
1420        VTAB  8 : HTAB 47 : INPUT "",CB
1430        VTAB  9 : HTAB 47 : INPUT "",CC
1440        VTAB 10 : HTAB 47 : INPUT "",CD
1450        VTAB 11 : HTAB 47 : INPUT "",CE
1460        VTAB 12 : HTAB 47 : INPUT "",CF
1470        VTAB 13 : HTAB 47 : INPUT "",CG
1480        VTAB 14 : HTAB 47 : INPUT "",CH
1490        VTAB 17 : HTAB  1 : PRINT ""
1500        PRINT TAB(20) "-----------------------------------"
1510        PRINT TAB(20) "I  ALL DATA HAS STORED IN COMPUTER  I"
1515        PRINT TAB(20) "I" SPC(35) "I"
1520        PRINT TAB(20) "I    ## PRESS RETURN FOR START ##   I"
1525        PRINT TAB(20) "I" SPC(35) "I"
1530        PRINT TAB(20) "-----------------------------------"
1535        INPUT "",AA
1540        IF AA=5 THEN 1200
1600     HOME : ' --- DATA ENTRY ---
1620     PRINT TAB(25) "==== DRAIN-6 PROGRAM ===="
1630     PRINT TAB(25) "-------------------------"
1640     PRINT
1650     PRINT TAB(33) "ENTER DATA"
1660     PRINT TAB(33) "----------"
1670     PRINT
1680     PRINT : PRINT TAB(25) "DEPTH OF INVERT --"
1690     PRINT : PRINT TAB(25) "PIPE DIAMETER   --"
1700     PRINT : PRINT TAB(25) "PIPE COST       -- $"
1710     PRINT
1720     PRINT TAB(20) STRING$ (40,".")
1730     PRINT : PRINT TAB(30) "BASIC COST -- $"
1740     PRINT : PRINT
1750     PRINT STRING$ (78,"-")
1760     PRINT "## PRESS '1' FOR DISPLAY DETAIL INFORMATION"
1765     PRINT "## PRESS '7' FOR RESTART"
1770     PRINT "## PRESS '9' FOR EXIT"
1780     PRINT "## PRESS RETURN FOR CONTINUE" SPC(20) "## CHOICE :"
1800        ' --- CURSOR POSITONING ---
1810        VTAB 8 : HTAB 44 : INPUT "",DI : DI=DI/1000
1820        VTAB 10 : HTAB 44 : INPUT "",DJ : DJ=DJ/1000
1830        VTAB 12 : HTAB 46 : INPUT "",CJ
1850             GOTO 2000
1860             GOTO 3000
1870             GOTO 4800
1880             GOTO 5000
1900 ' --- ENDING ---
1910 HOME
1920 VTAB 8 : HTAB 25 : PRINT "----------------------"
1930 PRINT TAB(25) "I                    I"
1940 PRINT TAB(25) "I   END OF DRAIN-6   I"
1950 PRINT TAB(25) "I                    I"
1960 PRINT TAB(25) "----------------------"
1999 END
```

```
2000 ' --- DC VALUE DETERMINATION ---
2005 DK=(2*DH)+DJ
2010 IF AC=0 THEN 2060
2015 X1=DJ*FA : X2=DK*FA
2020 IF AC=1 THEN 2025 ELSE 2040
2025 IF DC<X1 THEN DC=X1
2030 GOTO 2060
2040 IF AC=2 THEN 2050 ELSE 2060
2050 IF DC<X2 THEN DC=X2
2060 LET DC=DC
2070    '--- DD VALUE DETERMINATION ---
2080    IF AD=0 THEN 2130
2085    X3=DJ*FB : X4=DK*FB
2090    IF AD=1 THEN 2095 ELSE 2110
2095    IF DD<X3 THEN DD=X3
2100    GOTO 2130
2110    IF AD=2 THEN 2115 ELSE 2130
2115    IF DD<X4 THEN DD=X4
2130    LET DD=DD
2140       ' --- DE VALUE DETERMINATION ---
2150       IF AE=0 THEN 2220
2160       X5=DJ*FC : X6=DK*FC
2170       IF AE=1 THEN 2180 ELSE 2200
2180       IF DE<X5 THEN DE=X5
2190       GOTO 2220
2200       IF AE=2 THEN 2210 ELSE 2220
2210       IF DE<X6 THEN DE=X6
2220       LET DE=DE
2230       GOTO 1860
3000 ' --- EXCAVATION ---
3020 DN=DI+DH+DC+DG
3022 IF AH$="Y" THEN 3024 ELSE 3030
3024 GOTO 4500
3026 GOTO 3032
3030 D1M=DJ+2*(DH+DD+DF)
3032 IF DA=0 THEN 3034 ELSE 3040
3034 D2M=D1M
3036 GOTO 3050
3040 D2M=D1M+(DN*(DA/DB))*2
3050 VA=((D1M+D2M)/2)*DN
3100    ' --- PIPE ---
3110    DK=DJ+2*DH
3120    VI=3.14159*(DK/2)2
3200       ' --- BEDDING ---
3210       IF AB=1 THEN 3220 ELSE 3250
3220       DR=DJ+2*(DH+DD)
3230       DQ=DE+DJ+2*DH+DC
3240       VB=DQ*DR-VI/2 : VF=0
3245       GOTO 3400
3250          IF AB=2 THEN 3260 ELSE 3400
3260          DR=DJ+2*(DH+DD)
3270          DQ=DK/2+DC
3280          VB=(DQ*DR)-(VI/2)
3290          VF=0
3295 PRINT VG, DR, DK, VI
3400 ' --- BLINDING ---
3410 VC=D1M*DG
3500    '--- FORM WORK ---
3510    VE=DQ*1*2
3550       ' --- STEEL ---
3560       VH=DOSI*VB
3570       SAST=VH*7800
3600          ' --- FILTER ---
3620       VG=DR*(DK/2+.3)-(VI/2)
```

Appendix IX - D5

```
3650 ' --- AGGREGATE ---
3660 IF AG$="Y" THEN  3670 ELSE 3700
3670 LET VF=VB
3680 LET VB=0
3700     ' --- BACK FILL ---
3710     VD=VA-VB-VC-VF-VI-VG
3999     GOTO 1870
4000         ' --- TRENCH WIDTH ---
4005         IF AI=1 THEN 4010 ELSE 4200
4010         HOME :  PRINT TAB(10) "INT. PIPE DIA." SPC(15) "TRENCH WIDTH"
4020         PRINT TAB(10) "--------------" SPC(15) "------------"
4030         PRINT
4040         PRINT (1) : PRINT (2) : PRINT (3) : PRINT (4) : PRINT (5) : PRINT (6) : PRINT (7) : P
: PRINT (11) : PRINT (12) : PRINT (13) : PRINT (14) : PRINT (15) : PRINT (16) : PRINT (17) : PRINT
4043         PRINT STRING$ (78,"-")
4046         PRINT "## PRESS RETURN FOR CONTINUE"
4050         DIM SB(18) : DIM SD(18)
4060         FOR I=1 TO 18
4070           A=3+I
4080           VTAB A : HTAB 10 : INPUT "",B
4085           IF B=-1 THEN 4117 ELSE 4090
4090           B=B/1000 : SB(I)=B
4100           VTAB A : HTAB 40 : INPUT "",C : C=C/1000
4110           SD(I)=C
4115         NEXT I
4117         VTAB 23 : HTAB 30 : INPUT "",AA
4120         IF AA=0 THEN 1200
4130         IF AA= 5 THEN 4140 ELSE 4117
4140         ERASE SB : ERASE SD : GOTO 4010
4200   IF AI=2 THEN 4210 ELSE 1200
4210   HOME : PRINT TAB(10) "EXT.PIPE DIA." SPC(15) "TRENCH WIDTH"
4220   PRINT TAB(10) "-------------" SPC(15) "------------"
4230   PRINT
4240   PRINT (1) : PRINT (2) : PRINT (3) : PRINT (4) : PRINT (5) : PRINT (6) : PRINT (7) : PRINT (8
INT "(11)" : PRINT "(12)" : PRINT "(13)" : PRINT "(14)" : PRINT "(15)" : PRINT "(16)" : PRINT "(17)
4243   PRINT STRING$ (78,"-")
4246   PRINT "## PRESS RETURN FOR CONTINUE"
4250   DIM SC(18) : DIM SD(18)
4260   FOR I=1 TO 18
4270     A=3+I
4280     VTAB A : HTAB 10 : INPUT "",B
4285     IF B=-1 THEN 4330
4290     B=B/1000 : SB(I)=B
4300     VTAB A : HTAB 50 : INPUT "",C : C=C/1000
4310     SD(I)=C
4320   NEXT I
4330   VTAB 23 : HTAB 30 : INPUT "",AA
4335   IF AA=0 THEN 1200
4340   IF AA=5 THEN 4315 ELSE 4330
4345   ERASE SC : ERASE SD : GOTO 4210
4500 ' --- TRENCH WIDTH RETRIVAL ---
4510 IF AI=1 THEN 4520 ELSE 4560
4520   FOR I=1 TO 18
4525     LET M=SB(I) : LET N=SD(I)
4530     IF OJ=M THEN  4535 ELSE 4540
4535     DIM=N : GOTO 3026
4540   3026
4590   NEXT I
4600 GOTO 3026
```

```
4800          ' --- COST ---
4810          LET RA=VA*CA
4820          LET RB=VB*CB
4830          LET RC=VC*CC
4840          LET RD=VD*CD
4845          LET RE=VE*CE
4850          LET RF=VF*CF
4860          LET RG=VG*CG
4880          LET RH=SAST*CH/1000
4890          LET RI=DP : CI=RI
4900          LET RJ=CJ
4910          LET RZ=RA+RB+RC+RD+RE+RF+RG+RH+RI+RJ
4920          GOTO 1880
5000     ' --- SUBMIT BASIC COST ---
5010     VTAB 16 : HTAB 45 : PRINT RZ
5020     VTAB 23 : HTAB 61 : INPUT "",AA
5030     IF AA=1 THEN GOTO 8000
5035     IF AA=7 THEN 100
5040     IF AA=9 THEN 1900
5050     IF AA=0 THEN 1600
5060     GOTO 5020
8000 HOME : ' --- DISPLAY RESULT ---
8010 PRINT TAB(25) "==== COST DETAIL ===="
8020 PRINT TAB(25) "---------------------"
8040 PRINT TAB(25) "DEPTH OF INVERT -- "; DI*1000; " mm"
8050 PRINT TAB(25) "PIPE DIAMETER   -- "; DJ*1000; " mm"
8060 PRINT
8070 PRINT STRING$ (78,".")
8090 PRINT TAB(15) "UNIT COST" SPC(5) "QUANTITY" SPC(19) "RATE"
8100 PRINT TAB(15) "---------" SPC(5) "--------" SPC(19) "----"
8110 PRINT
8120 PRINT "EXCAVATION", CA, VA, ,RA
8130 PRINT "20/20 CONC.", CB, VB, ,RB
8140 PRINT "7/20 CONC.", CC, VC, ,RC
8150 PRINT "BACK FILL", CD, VD, ,RD
8160 PRINT "FORM WORK", CE, VE, ,RE
8170 PRINT "AGGREGATE", CF, VF, ,RF
8180 PRINT "S.F.M.", CG, VG, ,RG
8190 PRINT "PIPE COST", CJ, , ,RJ
8200 PRINT "PIPE LAYING", CI, , ,RI
8210 PRINT "STEEL", CH, VH, ,RH
8220 PRINT : PRINT STRING$ (78,".")
8230 PRINT TAB(50) "BASIC RATE : ";RZ
8240 PRINT STRING$ (78,"-")
8250 INPUT "## PRESS RETURN FOR CONTINUE ",AA
8255 IF AA=3 THEN 8500 ELSE 8260
8260 GOTO 1600
8500 ' --- CHECKING ---
8510      PRINT "DIMENSION VARIABLES  DA-DS"
8520      PRINT DA,DA,DC,DD,DE,DF,DG,DH,DI,DJ,DK,D1M,D2M,DN,DOST,DPPL,DQ,DR,DS
8530      PRINT "COST VARIABLES  CA-CJ"
8540      PRINT CA,CB,CC,CD,CE,CF,CG,CH,CI,CJ
8550      PRINT "ANSWERING VARIABLES AA-AI"
8560      PRINT AA,AB,AC,AD,AE,AF$,AG$,AH$,AI
8570      PRINT "AREA/VOLUME VARILBLES V1-VK"
8580      PRINT VA,VB,VC,VD,VE,VF,VG,VH,VI,VJ,VK
8590      PRINT "NUMERIC VARIABLES SAST-SD"
8600      PRINT SAST,SB,SC,SD
8610      PRINT "FACTOR VARIABLES FA-FC"
8620      PRINT FA,FB,FC
8630      PRINT "RATE COST VARIABLES RA-RZ"
8640      PRINT RA,RB,RC,RD,RE,RF,RG,RH,RI,RJ,RZ
8645         INPUT AA
8650 GOTO 8260
```

Appendix X

Appendix - X

Smaple Run

Page	Item No.	Pipe Diameter	Class	Bedding Type	Actual Rate	Trial Run	% Difference
2/5	C	225	S	1	162	154	+ 4.9
2/5	D	225	S	0	234	284	+ 21.4
2/5	E	300	H	1	180	235	+ 23.4
2/5	G	375	M	1	216	267	+ 23.6
2/5	H	375	M	0	306	388	+ 26.8
2/5A	A	450	M	0	324	385	+ 18.8
2/5A	C	450	M	1	315	308	- 2
2/5A	D	450	M	1	333	354	+ 6.3
2/5A	F	450	H	1	342	368	+ 7.6
2/6	A	525	M	1	387	395	+ 2.1
2/6	B	525	M	1	414	446	+ 7.7
2/6	D	600	M	1	468	478	+ 2.1
2/6	E	600	M	1	522	512	- 1.9
2/6	G	600	M	0	612	637	+ 4
2/6	H	600	M	0	614	637	+ 4

BIBLIOGRAPHY

"Computerised Construction Management System" Asian Architect and Contractor (December 1983)

Deborah Mr. Puretz "Automating the office: An Integrated Blueprint" Asian Computer Monthly (December 1983)